PRINCIPLES OF ANATOMY

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OF
ANATOMY

THE ABDOMEN PROPER
DESCRIBED AND ILLUSTRATED
BY TEXT AND PLATES

BY

WM. CUTHBERT MORTON
M.A., M.D.(Edin.)

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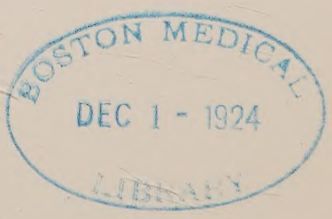

TO THE

MEMORY OF MY TEACHER

WILLIAM MILES

PRINCIPAL OF THE ROYAL COLLEGE
TRINIDAD, B.W.I.

AND TO

MY TEACHERS

SIR WILLIAM TURNER

PRINCIPAL, EMERITUS PROFESSOR OF ANATOMY
UNIVERSITY OF EDINBURGH

WILLIAM S. GREENFIELD

PROFESSOR OF PATHOLOGY, PROFESSOR OF CLINICAL MEDICINE
UNIVERSITY OF EDINBURGH

FRANCIS M. CAIRD

PROFESSOR OF CLINICAL SURGERY
UNIVERSITY OF EDINBURGH

THE AUTHOR'S APOLOGY FOR HIS BOOK

"When at the first I took my Pen in hand,
Thus for to write; I did not understand
That I at all a little Book should make
In such a mode; nor did I undertake
Thereby to please my Neighbour; no not I;
I did it mine own self to gratifie.

Thus I set Pen to Paper with delight,
And quickly had my thoughts in black and white.
For having now my Method by the end,
Still as I pull'd, it came; and so I penn'd
It down, until it came at last to be,
For length and breadth the bigness which you see.

Well, when I had thus put mine ends together,
I shew'd them others, that I might see whether
They would condemn them, or them justifie:
And some said, let them live; some, let them die.
Some said, Go, print it; others said, Not so:
Some said, It might do good; others said, No.

Now was I in a straight and did not see
Which was the best thing to be done by me:
At last I thought, Since you are thus divided,
I print it will; and so the case decided."

THE author is greatly indebted both to Prof. J. Kay Jamieson of Leeds University for assistance in verifying the details, particularly of the lymphatic system, and to Dr. Douglas E. Derry of University College, London, for correcting the proofs of the text. His best thanks are also due to the publishers for the attention and care which they have lavished upon every portion of the work.

Should the reception accorded to the present work warrant it, the author will be encouraged to apply his method to the other parts of the body at some future time.

LEEDS, *February* 1911.

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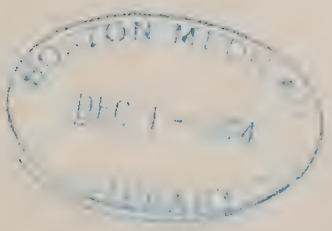
SECT.



PRINCIPLES OF ANATOMY

I. Anatomy is the study of the body as an organic unity built up of parts related to each other in a definite manner.*

The object of study is not the parts of the body, but the body itself regarded as a whole built up of parts.

II. The goal of anatomy is not the accurate knowledge of one or more bodies but as accurate a knowledge as possible of all bodies.

No two bodies are exactly alike. Consequently many bodies must be compared in order to obtain from their variations a true idea of the most frequent form, size, position, and relations of any part. This total is taken as the standard or norm for that part, and the standard or normal parts when built up in proper relation to each other form the standard or normal body. Two or more predominant variations may however occur with almost equal frequency, so that within certain limits the standard part may vary, and, if the standard part, much more the standard body. Other variations occurring less frequently are abnormal and not standard. **Anatomy is**

* The term Anatomy is here used in its primary sense, and it does not include microscopic anatomy.

concerned (1) with the standard or normal body and its variations, and (2) with abnormal variations.

III. The material of anatomy is the dead body.

Although much can be learned from the living body, the key to the living is the knowledge of the dead.

IV. The method of anatomy is at once destructive and constructive.

By dissection in the past the body has been reduced to its parts, in order that these might be studied, not only individually but also in relation to each other and to the whole. By the comparison of many bodies the standard or norm has been determined for each part, all variations being noted as normal or abnormal. Finally, the standard or normal parts have been built up into the standard or normal body.

The student of anatomy of the present day no longer requires to compare a large number of bodies with each other, but merely to compare a few bodies with a good description.

V. Anatomical description is concerned (1) with the normal body and its variations, and (2) with abnormal variations.

The description should resemble the body itself by being a unity built up of parts related to each other in a definite manner.

Anatomical description aims not at the accurate presentation of one or more bodies, but at as accurate a presentation as possible of all bodies. It therefore

presents (1) the complete normal body with its variations, and (2) abnormal variations. Since, however, the body is no mere conglomeration of parts but an organic unity in which the parts are related to each other in a definite manner, the description must not merely present the individual parts of the body, but must emphasise the manner in which the parts are related to each other in the whole.

Description by text can accomplish this by sequence of thought, each part of the body being described in natural sequence to what has gone before and in natural precedence to what is to follow. Description by plates can with greater verisimilitude present a complete normal body with all its parts in due relation, variations normal and abnormal being illustrated from actual dissections.

Description by text is necessarily diffuse, and the attention is apt to be so distracted by details that the unity of the whole is only faintly perceived. Description by plates is so concise and compact that the unity of the whole compels attention, and the details only speak when spoken to.

The accompanying description is the first instalment of an attempt to apply to the whole human body, in a thorough and consistent manner, the principles enunciated above. The description is confined to a "normal abdomen," an initial limitation which makes for simplicity while it can without difficulty be supplemented. The description consists of two complementary portions—(1) the plates, and (2) the text.

I.

THE PLATES.

The presentation of a normal abdomen has the obvious advantage, that the plates being in strict proportion are capable of correlation in many ways. The description consists of fourteen leaves, on most of which (*e.g.* leaf 3) two plates are placed in relation—one (3^a) on the front, the other (3^b) on the back of the leaf, the two together forming what may be called a "front-and-back plate," $3^{(a+b)}$. In each front-and-back plate of the organs the abdominal cavity has been outlined, and a portion of the leaf within the outline has been cut out.

A. **The front and back of each front-and-back plate can be correlated—**

(i) By **separate inspection** the relation of the structures is seen both from in front and from behind, *e.g.*, in 3^a the costal cartilages are concealed where they are posterior to the rectus muscle, whereas in 3^b the rectus muscle is concealed where it is anterior to the costal cartilages. Similarly, in 10^a the portal vein is concealed behind the neck of the pancreas, whereas in 10^b the neck of the pancreas is concealed in front of the portal vein.

(ii) By **simultaneous inspection by transillumination** the whole of each structure is seen in outline, *e.g.*, if leaf 3 be held between the observer and a good light and examined first from in front ($3^{a\,b}$) and afterwards from behind ($3^{b\,a}$), then $3^{a\,b}$ reveals the costal cartilages behind the rectus muscle, whereas $3^{b\,a}$ reveals the rectus muscle in front of the costal

cartilages. Similarly, $10^{a\,b}$ reveals the portal vein behind the neck of the pancreas, whereas $10^{b\,a}$ reveals the neck of the pancreas in front of the portal vein.

It should be carefully noted that part of a front-and-back plate may not only have no value but even be apt to mislead, except when seen by transillumination. Thus 1^{b}, 2^{b}, 4^{b}, 12^{b}, and 14^{a} are not to be studied separately but merely by transillumination as parts of $1^{a\,b}$, $2^{a\,b}$, $4^{a\,b}$, $12^{a\,b}$, and $14^{b\,a}$.

B. **The front-and-back plates can be correlated with each other—**

(i) By **separate inspection**; *e.g.*, if leaves 2, 3, 4, and 5 be placed side by side, then 2^{a}, 3^{a}, 4^{a}, and 5^{a} may be correlated for the spermatic cord and its coverings. Again, if leaf 1 be placed in front of leaf 14, then $1^{a}+14^{b}$ is practically a front-and-back plate of the whole skin surface of the abdomen proper.

(ii) By **combined inspection by means of cut-out leaves**; *e.g.*, 9^{a}, 10^{a}, 11^{a}, 12^{a}, give a front view of the colon, the duodenum, spleen, and pancreas, the suprarenal capsules and kidneys, and the posterior abdominal wall. Again, 11^{b}, 6^{b}, give a back view of the right suprarenal capsule and kidney in relation to the liver.

(iii) By **simultaneous inspection by transillumination**; *e.g.* in 1^{a}, 3^{a}, the skin surface is correlated with the costal arches, and in 3^{a}, 6^{a}, the costal arches are correlated with the liver, while in 1^{a}, 3^{a}, 6^{a}, the skin surface, the costal arches, and the liver are all in correlation. Similarly, $14^{b\,a}$, $13^{b\,a}$, $12^{b\,a}$, 11^{b}, give the deep posterior relations of the kidneys as seen from behind.

The above are merely a few examples of correla-

tion, and the plates may be used to simplify many problems, not only in pure anatomy, whether practical, regional, or systematic, but also in anatomy as applied to clinical and operative work. An example or two must suffice.

(*a*) Each organ can be studied completely, its surface anatomy, its parietal, visceral, and peritoneal relations, and its blood- and lymph-vascular and nervous supply.

(*b*) The peritoneal sac is presented in its entirety, and can be studied, not only in the usual way, by a consideration of the great and small sacs or by means of transverse and vertical sections, but also by being reduced to and rebuilt out of its parts.

C. **All the plates can be correlated** to form a complete presentation of a normal abdomen proper.

D. This is in turn capable of being correlated with the other "parts" of the body, *i.e.*, the thorax, head, and neck, etc., to form a complete presentation of a normal body.

E. Plates of actual dissections would then complete the presentation of the human body in all its variations. Such a presentation could be used by the student as a means of unifying his knowledge, of marshalling under his command the host of impressions gained at the dissecting-table, in the lecture-room, at the bedside, in the operating-theatre. It is intended not to rival but to stimulate practical study, to be used before dissection for a preliminary survey, during dissection for comparison and contrast, after dissection for revision, and at all times for reference. If also used in connection with clinical and operative work it would in course of time become something more than a collection of plates, and

would be to each mind a symbol of things which in the past the eyes had really seen, and the hands had actually handled.

II.

THE TEXT.

The text also in its own way illustrates the principles enunciated above. It may be regarded as a collection of word-pictures linked together in unbroken continuity and at the same time capable of further correlation. The unbroken continuity is rendered possible only by the systematic division and classification which is to be seen in the table of contents. The further correlation of the parts depends on the references in the text and also on the index, *e.g.*, §§ 131, 43, 29, 17, 6, describe the course of the deep epigastric artery.

It should be noted that neither in the plates nor in the text is any part to be judged by itself, since its value is largely determined by its relation to the whole, *e.g.*, plate 12^a if taken alone conveys a false idea of the peritoneal relations of the kidneys, and in §§ 74–85 the description of the liver is ordered by the needs of the peritoneum. Such a description may appear disjointed, yet if the plates and text be simultaneously consulted the objection ceases to be serious. It may not be easy to obtain a clear idea of the vascular supply of the stomach from the text alone, yet in the text the correlation of the vessels and nerves in territories serves a definite purpose, while the territories can easily be correlated by means of the plates.

Certain changes have been made in treatment and

in nomenclature, but never without a definite aim at clearness, conciseness, or ease in handling the facts. Among such changes are the following :—

The adoption of a middle abdominal ring, and the corresponding classification of inguinal herniæ (§§ 21, 23, 27, 42).

The treatment of the peritoneal sac (§ 34, and index). The lesser sac not a diverticulum of the greater (§ 98).

The definitions of peritoneal ligament, omentum, and mesentery, and the strict limitation of the peritoneal "fold" (§§ 34, 35).

The division of the colic omentum into gastric and colic portions (§ 47).

The division of the abdominal cavity into cœliac and mesenteric compartments (§ 48).

The division of the organs into paired and unpaired, and of the unpaired according to the compartments of the abdominal cavity (§ 50).

The constant grouping together of the vessels and nerves, and their classification in relation to the organs as paired- and unpaired-visceral (*e.g.* § 53).

The colic and other non-peritoneal lines and the colic square (§ 57).

The arterial territories (§§ 67, 113–116).

The interfissural area of the liver (§ 78).

The division of the duodenum, not only into "parts," but also into supramesocolic and inframesocolic portions, and into the floating and the fixed duodenum (§ 93).

The correlation of the great vessels and nerves (§§ 130–146).

The inclusion of the solar in the aortic plexus (§§ 143–146).

In conclusion, the plates and the text together form a single description. This is only a beginning, and as such has been kept within strict limits. It is, however, capable of unlimited expansion, and all in the direction of a complete harmonious description of the human body.

DISSECTION OF THE ABDOMEN PROPER.

READ 1–4.

Incise the skin vertically in the middle line from the xiphisternal junction to the symphysis pubis, and transversely on each side from the ends of the vertical incision to the midlateral line. Reflect the two flaps outwards.

Prolong the vertical incision downwards in front of the symphysis pubis and, skirting the penis with a circular incision, carry the knife to the lowest point of the scrotum in the middle line. From this point make a transverse incision on each side through the skin of the scrotum. Reflect the two scrotal flaps outwards.

READ 5.

Incise the superficial fascia vertically half an inch to the left of the middle line from the xiphisternal junction to the crest of the pubis.

On the left side dissect out the superficial vessels, glands, and nerves.

READ 7–9.

On the right side incise the superficial fascia from the right anterior superior iliac spine along the interspinous curved line as far as the vertical incision. The interspinous incision should first cut through the fatty superficial layer which must be lifted off the superficial inguinal vessels and glands, and then through the membranous deep layer which must in turn be lifted off the deep fascia so that its attachments may be clearly made out.

Note. — The *interspinous curved line* is an imaginary line connecting the two anterior superior iliac spines. It is convex downwards, the lowest point being in the middle line an inch and a half above the symphysis pubis.

Incise and reflect the superficial fascia of the scrotum as was done in the case of the skin. Note the fusion of the two layers.

Remove the superficial fascia above the interspinous curved line, thus defining the deep fascia.

Read 6, 10–15.

Incise the anterior lamella of the rectus sheath along its whole length close beside the linea alba about an inch from the middle line. Separate the sheath from the inscriptiones tendineæ. Pass the hand behind the anterior lamella to the outer border of the muscle and then (*a*) inwards behind the rectus muscle, (*b*) outwards where possible behind the lateral muscles.

Read 16.

Detach the pyramidalis muscle from the linea alba and reflect outwards and downwards to expose the nerve of supply.

Detach the insertion of the rectus muscle from the thoracic wall and reflect downwards, noting the vessels and nerves.

READ 17, 18.

Remove the deep fascia from the obliquus externus muscle above the interspinous curved line. Note the iliohypogastric and ilio-inguinal nerves.[31]

READ 19, 20.

Remove as much of the obliquus externus as lies above the interspinous curved line between the outer border of the rectus and the midlateral line. Incise the intercolumnar evagination longitudinally and carry the incision upwards in the direction of the "warp" of the aponeurosis as far as the interspinous curved line. Reflect towards each side of the incision.

Define the obliquus internus muscle, noting the iliohypogastric and ilio-inguinal nerves.[31]

READ 21, 22.

Remove as much of the obliquus internus as lies above the interspinous curved line between the outer border of the rectus and the midlateral line. Incise the cremasteric evagination longitudinally and carry the incision upwards to the interspinous curved line. Reflect towards each side of the incision.

Define the transversalis muscle, noting the vessels and nerves.

READ 23, 24, 29–31.

Incise along the interspinous curved line through transversalis muscle, rectus sheath and contents and linea alba. Remove as much of these structures as

lies above the interspinous curved line between the midlateral lines. Note the relation of the transversalis muscle to the cremasteric evagination.

Define the fascia transversalis.

Read 25–28.

Remove the fascia transversalis above the interspinous curved line between the midlateral lines. Incise the infundibuliform evagination longitudinally and carry the incision upwards to the interspinous curved line. Reflect towards each side of the incision.

Read 32–38.

Incise the extraperitoneal connective tissue and peritoneum on each side from the umbilicus to the midlateral line. Note the obliterated umbilical vein and falciform ligament.

Incise the extraperitoneal connective tissue and peritoneum on each side of the parietal attachment of the falciform ligament up to the costal margin and reflect the two flaps. Note the urachus, obliterated hypogastric arteries, and deep epigastric arteries, with the inguinal folds and fossæ and the femoral fossa.

Read 39–41.

Incise the extraperitoneal connective tissue and peritoneum on each side from the umbilicus downwards and outwards just external to the deep epigastric artery as far as the interspinous curved line, then follow this line outwards to the anterior superior iliac spine. Reflect the flaps.

Read 42.

Define the deep epigastric and deep circumflex iliac vessels.

READ 43–47.

Incise vertically through the gastric portion of the colic omentum. Insert one hand through this incision above, and pass the other hand below, the transverse colon and mesocolon.

READ 48–63.

Turn the jejuno-ileum first to the left and then to the right in order to expose the inframesocolic portion of the duodenum and the duodeno-jejunal flexure.

READ 64–66, 73.

Have a formalin-hardened liver as model.

READ 74.

Pass the hands above the margin of the liver over the parietal surface, one on each side of the falciform ligament.

READ 75, 76.

Placing the left hand on the parietal surface of the liver, pass the right hand below the margin over the visceral surface.

READ 77–82.

Insert the right hand through the incision in the gastric portion of the colic omentum.

READ 83.

Return the right hand beneath the margin of the liver.

Read 84–88.

Place both hands beside the transverse fissure, the left in front of, and the right (through the incision in the colic omentum) behind, the hepatic omentum.

Read 89.

Note the œsophagus, stomach, and supramesocolic portion of the duodenum.

Read 90–93.

Note the constitution and attachments of the gastric sheet with the resulting small sac of peritoneum.

Read 94–99.

Have a formalin-hardened spleen as model. Place one hand on each side of the lienorenal ligament.

Read 100–104.

Have a formalin-hardened pancreas as model. Place one hand above and the other below the transverse mesocolon.

Read 105–111.

Have formalin-hardened suprarenal capsules and kidneys as models.

Read 120–128.

Liver and Gall-Bladder (plate 6).

Revise 74–89. — Raise the liver by its anterior margin.

Dissect the structures in the hepatic omentum,

namely—(*a*) The common bile-duct,[88] hepatic artery, portal vein, hepatic lymph-vessels and glands, and hepatic nerves[116,117]; (*b*) the coronary vessels and glands and nerves[114]; (*c*) the pyloric vessels and glands and nerves[116]; (*d*) the left pneumogastric nerve.[118] Sever the attachment of the hepatic omentum along the lesser gastric line. Sever the right lateral, coronary, left lateral, and falciform ligaments. Remove the liver and gall-bladder, severing the hepatic veins so as to leave the inferior vena cava *in situ*.

Œsophagus, Stomach, and Floating Duodenum (PLATE 7).

REVISE 90–99, noting the gastrophrenic ligament, the splenic omentum with the vasa brevia,[115] and the colic omentum with the left[115] and right gastro-epiploic[116] vessels and nerves. Sever the œsophagus and the pneumogastric nerves,[118] also the gastrophrenic ligament. Sever the splenic omentum beside the hilus of the spleen, and the colic omentum beside the transverse colon. Sever the floating duodenum at its termination. Remove the œsophagus, stomach, and floating duodenum with the omenta.

Jejuno-ileum (PLATE 8).

REVISE 66. — Sever the jejunum about 3 inches below the duodenojejunal flexure, and the ileum about the same distance above the ileocæcal junction. Dissect the superior mesenteric vessels and glands and nerves, in so far as they are found in the mesentery proper. Sever the mesentery proper along the enteric line. Remove the jejuno-ileum.

Colon (PLATE 9).

REVISE 56–63.—Dissect the ileocolic, the right and middle colic portions of the superior, and the whole of the inferior mesenteric vessels and glands and nerves.[67 72] Remove the colon, leaving as much peritoneum as possible wherever the colon is fixed and severing the transverse mesocolon along the transverse colic line.

Fixed Duodenum, Spleen, Pancreas (PL. 10).

Duodenum.

REVISE 65, 93, noting the pancreaticoduodenal vessels and glands and nerves.[68, 116, 117].

Spleen.

REVISE 100–104, dissecting the corresponding portion of the splenic vessels and glands and nerves.[115] Sever the lienorenal ligament along the greater gastric line.

Pancreas.

REVISE 105–111.—Draw the spleen forwards and, lifting the pancreas by the tail, gradually free its posterior surface from left to right. Note[119] the vessels and glands and nerves in relation to the pancreas. Remove the fixed duodenum, spleen, and pancreas.

Unpaired-visceral Vessels and Nerves.

REVISE 67–72, 112–119.

Paired Organs, i.e., Suprarenal Capsules, Kidneys, and Testes (PLATE 11).

Paired-visceral and Great Vessels and Nerves.

Revise 120–128, noting the paired-visceral vessels and nerves.[129]

Dissect the great vessels and nerves[130–146] as far as possible without raising them off the posterior abdominal wall. Sever the inferior vena cava and aorta above and the external and internal iliac vessels below, also the inferior phrenic, lumbar, and middle sacral vessels. Remove the paired viscera and their vessels along with the great vessels and nerves, leaving only the receptaculum chyli and thoracic duct, and the semilunar ganglia and lumbar portion of the sympathetic cords. Then remove these also.

Note and remove the peritoneum which remains on the roof of the abdominal cavity. Note and remove the bounding fascia, defining the diaphragm and its vessels and nerves.

Read 147–152.

Note and remove the peritoneum which remains on the posterior abdominal wall. Note and remove the bounding fascia, defining the muscles, vessels, and nerves.

Read 153, 154.

Note the lateral muscles with the posterior aponeurosis of the transversalis.

Read 155, 156.

Note the posterior muscles.[157, 158] Scrape away the quadratus lumborum and iliopsoas, noting the parietal vessels and nerves.[160–165.] Remove the aponeurotic layer in front of the erector spinæ. The erector spinæ muscle and all structures[159, 166, 167] posterior to it are usually dissected from the back.

THE ABDOMEN PROPER.

1. The **abdomen** is that portion of the trunk which lies below the level of the diaphragm. It is divided by the pelvic brim into the abdomen proper above and the true pelvis below.

The **abdomen proper** may for convenience of description be divided into

I. The anterior and lateral abdominal walls.
II. The cavity of the abdomen proper.
III. The roof of the abdomen and the posterior abdominal wall.

I.

2. ANTERIOR AND LATERAL ABDOMINAL WALLS.

The anterior and lateral abdominal walls are limited above towards the thorax by the xiphisternal junction and the costal margins, and below towards the perineum and the thigh by the pubic symphysis and crests, the ligaments of Poupart,[19] and the iliac crests. They consist of

i. Skin and superficial fascia.
Vessels and nerves.

ii. Musculo-aponeurotic wall.
(*a*) Deep fascia.
(*b*) Muscles and aponeuroses.
(*c*) Bounding fascia.
Vessels and nerves.

Note.—Above, between the costal margins, is the **subcostal angle**, which is truncated at the xiphisternal junction. The xiphisternum projects into the apex of the angle, being embedded in the anterior abdominal wall.

Below, from the symphysis pubis outwards on each side, the order of structures is—pubic crest and spine, Poupart's ligament, anterior superior iliac spine, and iliac crest. The highest point of the iliac crest as seen from in front is close beside the tubercle on the outer lip, about 2 inches behind the anterior superior spine.

3. *Note.*—**Subdivision of the abdomen into zones and regions.**[52]

On the walls of the abdomen two horizontal and two vertical lines are drawn representing antero-posterior planes, which divide the abdominal cavity into three zones and nine regions.

Horizontally, the **subcostal line** at the level of the lower border of the 10th costal cartilages and the **intertubercular line** at the level of the tubercles on the iliac crests mark out three **zones—costal, umbilical,** and **hypogastric,** in order from above downwards.

Vertically, the **Poupart lines** drawn through the mid-points between the symphysis pubis and the anterior superior iliac spines mark the subdivision of these zones into nine **regions**—between the Poupart

lines the **epigastric, umbilical,** and **hypogastric** regions, and external to each Poupart line the **hypochondriac, lumbar,** and **iliac** regions, in each case in order from above downwards.

The subcostal plane cuts the upper part of the 3rd lumbar vertebra or the disc above it, the intertubercular plane cuts the middle or upper part of the 5th lumbar vertebra.

The **transpyloric plane,** as employed by Addison, cuts the anterior abdominal wall at the mid-point between the suprasternal notch and the upper border of the pubic symphysis, at or near the mid-point between the xiphisternal junction and the umbilicus. It passes through the pylorus and cuts the lower border of the 1st lumbar vertebra.

The area above the pubis is known as the **suprapubic region,** and that beside Poupart's ligament as the **inguinal region or groin** (Regio inguinalis).

4. I. SKIN AND SUPERFICIAL FASCIA.

The **SKIN** (Cutis) passes upwards over the thorax, downwards over the perineum and the thigh. The upper limit is often traceable by a furrow, the lower is marked by the fold of the groin and the crest of the pubis. In the perineum the skin presents two evaginations, a **tubular process** which sheathes the penis as far as the glans, and a **scrotal bag** [5, 6] which holds the testes.

The **umbilicus** (Id.) is situated in the middle line, usually a little below the mid-point between the xiphisternal junction and the symphysis pubis. It is a scar marking the point of attachment of the umbilical cord, which shortly after birth drops off [14]

carrying with it the extra-abdominal portion of the placental circulation [39] and that of the fœtal allantois.[39]

The rectus abdominis muscles [16] are more or less outlined by furrows—internally, along the linea alba, especially above the umbilicus; externally, along the lineæ semilunares, and transversely along the lineæ transversæ.

5. The **SUPERFICIAL FASCIA** (Tela subcutanea) is composed of connective tissue in which may be embedded a considerable quantity of fat. It is continuous above with the superficial fascia of the thorax, and below with that of the perineum and of the thigh. In the lower part of the abdomen it can be differentiated into two layers between which lie the superficial inguinal blood- and lymph-vessels and glands.[7]

The **superficial layer** is fatty. It is uninterruptedly continuous (α) across the middle line, (β) towards the perineum, (γ) towards each thigh.

The **deep layer** is membranous. It is tacked down to the subjacent deep fascia or aponeurosis (α) in the middle line, and also (γ) towards each thigh from the pubic spine outwards along the inner and just below the outer part of Poupart's ligament. In the intervals between the symphysis pubis and the pubic spines it has no such attachment, but is uninterruptedly continued into the perineum where it is tacked down on each side to the front of the body of the os pubis, the side of the pubic arch, and the posterior border of the triangular ligament. The superficial fascia, which in this region is not differentiated into layers, thus forms a flattened pouch. In front of the pubis this pouch has two evaginations, a **tubular process** which sheathes the penis as far as

the glans, and a **scrotal bag**[4, 6] (Scrotum) which holds the testes. Over both these evaginations fat is wanting; over the scrotum, fibres of the involuntary **dartos muscle** (Tunica dartos) are found. On the anterior abdominal wall the pouch is bisected by the mesial attachment of the deep layer; the scrotal bag is bisected by a mesial septum (Septum scroti), which towards the penis is incomplete; in the perineum a mesial septum extends from the superficial fascia to the median raphe of the bulbo-cavernosus muscle.

The layers have received various names in the different parts—

	Superficial Layer.	Deep Layer.
In the groin . .	Fascia of Camper.	Fascia of Scarpa.
Above the penis . .		False suspensory ligament of the penis.
Over the scrotum .	Tunica dartos.	
Over the perineum .	Fascia of Colles.	

6. *Note.*—**Spermatic cord**[12] (Funiculus spermaticus). Beside the pubic spine on each side, beneath the skin and superficial fascia, lies the spermatic cord which contains[12b] the vessels and nerves of the testis together with its duct, the vas deferens. The **scrotal bag**[4, 5] of skin and superficial fascia is common to both testes. These are, however, separated by the **scrotal septum,** and in addition each testis and cord lies within a saccular process which is really an evagination of the musculo-aponeurotic wall consisting of various layers called the coverings of the cord.[27]

7. VESSELS AND NERVES OF THE SKIN AND SUPERFICIAL FASCIA.

Arteries.	Veins.	Lymph Streams.	Nerves (spinal).
Anterior cutaneous.			Anterior cutaneous.
Lateral cutaneous.			Lateral cutaneous.
Superficial inguinal or Groinward.			
Axillaward.			

ARTERIES.

The **anterior cutaneous** arteries, branches of the superior and deep epigastric arteries,[17] emerge from the rectus sheath in company with the anterior cutaneous nerves.

The **lateral cutaneous** branches of the 10th and 11th intercostal and the subcostal arteries[29] appear round the side.

The **superficial inguinal** branches of the femoral artery[131] come from the thigh. They lie between the two layers of the superficial fascia.[5]

The **superficial circumflex iliac** artery (A. circumflexa ilium superficialis) runs upwards and outwards as far as the anterior superior iliac spine.

The **superficial epigastric** artery (A. epigastrica superficialis) runs upwards and inwards towards the umbilicus.

The **superficial external pudic** artery (one of the Aa. pudendæ externæ) runs upwards and inwards towards the spine of the pubis and in front of the spermatic cord.

8. VEINS.

The **superficial inguinal or groinward** veins drain the skin and superficial fascia below the umbilicus into the internal saphenous, a tributary of the femoral vein.

The **axillaward** veins drain the skin and superficial fascia above the umbilicus into the axillary vein.

LYMPH STREAMS.

The **superficial inguinal or groinward** lymph stream drains the skin and superficial fascia below the umbilicus partly into the superficial inguinal *glands*[139] (supero-external and supero-internal groups), partly into the deep femoral *glands*.

The **axillaward** lymph stream drains the skin and superficial fascia above the umbilicus into the axillary *glands*, which are all deep.

9. NERVES (SPINAL).

I. Anterior cutaneous.

(α) **7th to 12th thoracic.**

The anterior cutaneous branches of the 7th to 12th thoracic nerves[17] pierce the anterior lamella of the rectus sheath in company with the anterior cutaneous arteries at the following levels: the 7th opposite the ensiform cartilage, the 10th opposite the umbilicus, and the 12th midway between the umbilicus and the pubis.

(β) **1st lumbar.**[31]

The **iliohypogastric** branch (N. iliohypogastricus) of the 1st lumbar nerve pierces the aponeurosis of the obliquus externus 1½ inches above

the external abdominal ring to terminate in its anterior cutaneous or **hypogastric** branch (Ramus cutaneus anterior), which supplies the skin below the 12th thoracic nerve and above the pubis.

The **ilio-inguinal** branch (N. ilio-inguinalis) of the 1st lumbar nerve passes through the external abdominal ring and pierces the intercolumnar fascia to terminate in its anterior cutaneous or **inguinal** branch (Nn. scrotales anteriores), which supplies the skin of the root of the penis, the scrotum, and the adjacent part of the thigh.

II. Lateral cutaneous.

(α) 9th to 12th thoracic.[31]

The lateral cutaneous branches of the 9th to 11th thoracic nerves appear at the side along with the lateral cutaneous arteries. Becoming superficial on the thoracic wall along the line of the interdigitations of the obliquus externus with the serratus magnus and latissimus dorsi muscles they descend to supply the skin of the abdominal wall, the 11th even crossing the iliac crest.

The lateral cutaneous (or **iliac**) branch of the 12th thoracic nerve becomes superficial about 2 inches behind the anterior superior iliac spine and crosses the iliac crest to supply the skin in the fore part of the gluteal region.

(β) 1st lumbar.[31]

The **iliohypogastric** branch (N. iliohypogastricus) of the 1st lumbar nerve gives off an **iliac** branch which becomes superficial below and behind the corresponding branch of the 12th thoracic nerve and crosses the iliac crest to supply the skin in the gluteal region.

II. MUSCULO-APONEUROTIC WALL.

10. The musculo-aponeurotic wall consists of

(*a*) Deep fascia.
(*b*) Muscles and aponeuroses.
(*c*) Bounding fascia.
Vessels and nerves.

11. (*a*) The **DEEP FASCIA** [159] on each side invests the superficial aspect of the obliquus externus muscle over the aponeurosis, of which it becomes so thinned as to be almost lost.[12] It is continuous above with the deep fascia of the thorax, covering the pectoralis major and serratus magnus muscles; below, it is attached to the os pubis, Poupart's ligament, and the iliac crest.

12. *Note.*—**Spermatic cord.**[6, 20]—Beside the **external abdominal ring** the deep fascia is delicate. It combines with the intercolumnar fibres of the obliquus externus aponeurosis [19] to form the outer covering [27] of the cord, namely, the **intercolumnar or external spermatic fascia.**

13. (*b*) **MUSCLES AND APONEUROSES.**

(*a*) Linea alba.
(*β*) Rectus sheath with the anterior muscles.
(*γ*) Lateral muscles.

14. (*a*) The **LINEA ALBA** (Id.) extends from the ensiform cartilage to the symphysis pubis. On each side the **aponeuroses of the lateral muscles** unite to form a single layer, the fibres of which interlace in the middle line with those of its fellow-layer forming the linea alba. Above the umbilicus, where the recti

are some distance apart, the linea alba is broad in the transverse direction; below the umbilicus, where the recti are side by side, the linea alba is broad in the antero-posterior direction. Opposite the umbilicus a hole or ring (Annulus umbilicalis) is present until birth, to allow various constituents of the umbilical cord to enter or leave the abdominal cavity. When the cord drops off, this ring becomes closed.[4, 39]

(β) RECTUS SHEATH WITH THE ANTERIOR MUSCLES.

15. The **rectus sheath** (Vagina m. recti abdominis) of each side is *limited* internally by the linea alba and externally by the linea semilunaris, and it is crossed by the lineæ transversæ. The **linea alba** has just been described. The **linea semilunaris** merely marks the outer border of the rectus muscle. The **lineæ transversæ** are three irregularly transverse furrows along which the sheath is adherent to the inscriptiones tendineæ,[16] three tendinous intersections in the rectus muscle.

16. The rectus sheath is *composed* of the aponeuroses of the lateral muscles.[19, 21, 23]

Above the costal margin it consists of the obliquus externus in front and is wanting behind. At this level the rectus muscle rests directly upon the thoracic wall.

From the costal margin to the level of the iliac crest it consists of the obliquus externus and obliquus internus in front, and of the obliquus internus and transversalis behind.

Below the level of the iliac crest it consists of the obliquus externus, obliquus internus and transversalis in front, and is wanting behind.

The thick posterior lamella of the sheath ends below in a border which is concave downwards and is called the **semilunar fold of Douglas.**[21, 23] Below this border the rectus muscle rests directly upon fascia transversalis.

The rectus sheath *contains* the

Anterior muscles.

PYRAMIDALIS (M. pyramidalis). *Origin*, from the pubic crest in front of the rectus. *Insertion*, into the lower part of the linea alba.

RECTUS ABDOMINIS (M. rectus abdominis). *Origin*, by an inner head from the ligaments in front of the pubic symphysis and by an outer head from the pubic crest. *Insertion*, into the front of the ensiform cartilage and the front of the 7th, 6th, and 5th costal cartilages. Each rectus muscle is limited internally by the linea alba and externally by the linea semilunaris and it is crossed by the **inscriptiones tendineæ** (Id.), three irregularly transverse tendinous intersections which are adherent to the anterior layer of the sheath along the lineæ transversæ,[15] being situated one opposite the ensiform cartilage, one midway between the ensiform and the umbilicus, and one opposite the umbilicus. Above the umbilicus the recti are some distance apart, below the umbilicus they are side by side.

17. VESSELS AND NERVES OF THE RECTUS SHEATH.

Arteries.	Veins.	Lymph Streams.	Nerves (spinal).
Superior epigastric.			
Deep epigastric.			
			7th to 12th thoracic.

ARTERIES.

The **superior epigastric** artery[29] (A. epigastrica superior) enters the rectus sheath above, between the sternal and costal origins of the diaphragm, and almost immediately enters the rectus muscle. It gives off **muscular** and **cutaneous**[7] branches, the latter set piercing the anterior lamella of the rectus sheath.

The **deep epigastric** artery[29] (A. epigastrica inferior) enters the rectus sheath below over the semilunar fold of Douglas. Ascending for some distance behind, it finally enters the rectus muscle to anastomose with the superior epigastric artery. It gives off **muscular** and **cutaneous** branches, the latter set piercing the anterior lamella of the rectus sheath.

VEINS correspond to the arteries.

Superior epigastric (V. e. s.).

Deep epigastric (V. e. i.).

LYMPH STREAMS.

The **superior epigastric** lymph stream accompanies the superior epigastric artery and ascends to the internal mammary *glands.*

The **deep epigastric** lymph stream accompanies the deep epigastric artery and descends to the external iliac *glands.*[139]

NERVES (SPINAL).

The **7th to 12th thoracic** nerves (anterior branches[31] of their anterior primary divisions) enter the rectus sheath either above the posterior lamella of the obliquus internus aponeurosis or by piercing the same lamella not far from the outer border of the

rectus. They supply **muscular** branches to the rectus, the 12th supplying the pyramidalis also, and they all end in **anterior cutaneous**[9] branches which pierce the anterior lamella of the rectus sheath.

18. (γ) **LATERAL MUSCLES.**

Obliquus externus.
Obliquus internus.
Transversalis.

19. **OBLIQUUS EXTERNUS** (M. obliquus externus abdominis). *Origin*, above, from the superficial aspect of the 12th to 5th ribs. *Insertion*, in the middle line from the ensiform cartilage along the linea alba to the symphysis pubis and below into the ligaments in front of the symphysis pubis, the pubic spine, Poupart's ligament, and the anterior superior iliac spine and outer lip of the iliac crest in its anterior half. Behind,[156] between insertion and origin the muscle has a free border.

Above the costal margin the fleshy slips of origin interdigitate with the latissimus dorsi[158] and serratus magnus muscles, and the aponeurosis gives partial origin to the pectoralis major, forming at the same time the **anterior lamella of the rectus sheath.**[16]

Below the costal margin the aponeurosis joins the obliquus internus a little internal to the linea semilunaris, helps to form the **anterior lamella** of the rectus sheath,[16] and is ultimately inserted along the **linea alba.**[14] Above the umbilicus, where the linea alba is wide, the decussation of fibres is well marked; below the umbilicus it is less definite. As the symphysis is approached, the fibres of each side after decussation form a separate lamina which descends behind the opposite obliquus externus to be inserted

into the opposite pubic crest and iliopectineal line. This is called the **triangular fascia** (Lig. inguinale reflexum Collesi). At the lower end of the linea alba the decussation is continued downwards for some distance in front of the symphysis.

Along the pubic crest the aponeurosis of the same side has no attachment from symphysis to spine, for the fibres which form the **internal pillar** (Crus superius) of the external abdominal ring pass onwards to the ligaments in front of the symphysis.

Beside the pubic spine the insertion is interrupted by the **external abdominal ring** (Annulus inguinalis subcutaneus) which forms the exit of the **inguinal canal**[28] (Canalis inguinalis), and is simply due to a separation of the fibres of the "warp" of the aponeurosis, *i.e.*, to a separation of those fibres of the aponeurosis which pass downwards and inwards. The fibres attached to the ligaments in front of the symphysis form the internal pillar of the ring, those attached to the pubic spine in continuity with Poupart's ligament form the **external pillar** (Crus inferius). The split is prevented from extending in length or breadth by the **arcuate** and **intercolumnar fibres** (Fibræ intercrurales) which are merely a thickening of the "woof" of the aponeurosis, and pass the former above, the latter across, the ring. From the external abdominal ring the intercolumnar fibres combined with the deep fascia[12] descend to form the evagination which constitutes the outer covering[27] of the spermatic cord and testis,[20] namely, the **intercolumnar or external spermatic fascia** (Fascia cremasterica Cooperi).

Between the pubic and anterior superior iliac spines the aponeurosis ends in **Poupart's ligament** (Lig. inguinale Pouparti), a strong fascial band to

which are attached the deep fascia, lateral muscles, and bounding fascia of the abdomen, and the fascia lata or deep fascia of the thigh. At its pubic end Poupart's ligament is prolonged horizontally backwards, to be inserted along the iliopectineal line. This additional triangular band of fibres, known as **Gimbernat's ligament** (Lig. lacunare Gimbernati), supports the spermatic cord on its upper surface and has a free concave outer edge bounding the crural ring. That part of Poupart's ligament which is in front of the femoral vessels is called the **superficial crural arch.**

Along the crest of the ilium the insertion is by muscular fibres.

Behind, between insertion and origin, the muscle has a free border.

20. *Note.*—The **spermatic cord** [12, 22] lies behind that portion of the aponeurosis which is inserted into the inner half of Poupart's ligament and the pubic spine. It rests upon Poupart's and Gimbernat's ligaments in front of the triangular fascia and it emerges through the **external abdominal ring,**[19] where it receives from the obliquus externus aponeurosis and deep fascia [12] its outer covering,[27] namely, the **intercolumnar or external spermatic fascia.**

21. OBLIQUUS INTERNUS (M. obliquus internus). *Origin*, below, from the outer half of Poupart's ligament, the anterior superior iliac spine, and the iliac crest in its anterior half between the outer and inner lip, and behind [156] from the lumbar fascia. *Insertion*, above, by muscular fibres into the lower border of the 12th, 11th, and 10th costal cartilages, and then by aponeurosis—in the middle line from the ensiform cartilage along the linea alba to the symphysis pubis,

and below into the pubic crest and the iliopectineal line.

From the costal margin to the level of the iliac crest the aponeurosis splits at the linea semilunaris into two portions which form the **anterior and posterior lamellæ** of the rectus sheath,[16] uniting once more to form the **linea alba.**[14] The anterior portion is joined just internal to the linea semilunaris by the aponeurosis of the obliquus externus, but its fibres can be distinctly traced inwards for some distance; it has no free border above, the anterior lamella of the rectus sheath being continued upwards by the obliquus externus. The posterior portion is somewhat similarly joined by the aponeurosis of the transversalis: above, it has a slight attachment to the lower border of the 9th, 8th, and 7th costal cartilages; below, it ends in a border which is concave downwards and is called the **semilunar fold of Douglas**[16, 23] (Linea semicircularis Douglasi).

Below the level of the iliac crest the fibres which arise from Poupart's ligament join the corresponding fibres of the transversalis to form the **conjoined tendon**[23] (Falx aponeurotica inguinalis), which passes altogether in front of the rectus and is inserted along the pubic crest, behind the pubic spine, and for some distance along the iliopectineal line.

Between insertion and origin the muscle presents a border which is concave downwards, arching over the **inguinal canal.**[23] The arch, consisting internally of the conjoined tendon and more externally of muscular fibres, stands upon Poupart's ligament along with which it forms the **middle abdominal ring,**[23] and from this ring muscular (M. cremaster) and connective-

tissue fibres descend to form the evagination which constitutes the middle covering[27] of the spermatic cord and testis,[22] namely, the **cremasteric or middle spermatic fascia.**

22. *Note.*—The **spermatic cord**[20, 24] passes obliquely beneath the arch of the lower border. Externally the cord is behind the muscular fibres, internally it is in front of the conjoined tendon. Along with Poupart's ligament the arch constitutes the **middle abdominal ring**[21, 23] from which the cord receives its middle covering,[27] namely, the **cremasteric or middle spermatic fascia.** This covering contains the *cremaster muscle*, which is supplied by the *cremasteric branch of the deep epigastric artery*[43] and the *genital branch of the genitocrural nerve* from the 1st and 2nd lumbar nerves.[164]

23. **TRANSVERSALIS** (M. transversus abdominis). *Origin*, below, from the outer third of Poupart's ligament, the anterior superior iliac spine and the inner lip of the iliac crest in its anterior half; behind,[156] from the lumbar fascia, and above from the deep surface of the 12th to 7th costal cartilages. *Insertion*, by aponeurosis in the middle line from the ensiform cartilage along the linea alba to the symphysis pubis, and below into the pubic crest and the iliopectineal line.

Beside the costal margin the muscular slips from the deep surface of the costal cartilages interdigitate with the slips of the diaphragm.[149]

From the costal margin to the level of the iliac crest it joins the obliquus internus a little internal to the linea semilunaris, helps to form the **posterior lamella** of the rectus sheath (which ends below in the **semilunar fold of Douglas**)[16, 21] (Linea

semicircularis Douglasi) and is ultimately inserted along the **linea alba.**[14]

Below the level of the iliac crest the fibres which arise from Poupart's ligament join the corresponding fibres of the obliquus internus to form the **conjoined tendon**[21] (Falx aponeurotica inguinalis) which passes altogether in front of the rectus and is inserted along the pubic crest, behind the pubic spine, and for some distance along the iliopectineal line.

Between insertion and origin the muscle presents a border which is concave downwards, forming a lofty arch over the **inguinal canal.**[28] The arch consists internally of the conjoined tendon, and more externally of muscular fibres which are not in immediate relation with the spermatic cord. The conjoined tendon forms part of the **middle abdominal ring.**[21, 24]

24. *Note.*—The **spermatic cord**[22, 26] passes obliquely beneath the lofty arch of the lower border. Externally and above, the cord is not in contact with the muscle; internally, it is in front of the conjoined tendon. The conjoined tendon forms part of the **middle abdominal ring**[21, 23] from which the cord receives its middle covering,[27] namely, the **cremasteric or middle spermatic fascia.**

25. (*c*) **BOUNDING FASCIA.**[148, 154] The bounding fascia of the abdomen proper covers the deep surface of the muscles and aponeuroses which bound the abdominal cavity. Where the cavity is bounded by bone, the place of the bounding fascia is taken by ligament or periosteum. On the anterior and lateral walls, it is conveniently called the **fascia transversalis** (Id.) It is continuous across the middle line, covering the trans-

versalis muscles and aponeuroses. It also on each side bridges the intervals where these muscles[23] are wanting, namely, below the semilunar fold of Douglas in the lower part of the rectus sheath, and below the lower border opposite the entrance to the **inguinal canal.** In the latter place at the **internal abdominal ring** the fascia gives off a funnel-shaped evagination which constitutes the inner covering[27] of the spermatic cord and testis,[26] namely, the **infundibuliform or internal spermatic fascia.**

Above, the fascia is continued over the roof of the abdomen as the delicate diaphragmatic fascia.[148]

Below,

Internally, it is tacked down to the pelvic brim in indirect continuity with the bounding fascia of the pelvis.

Externally, and in front, it is tacked down to the inner lip of the iliac crest and the posterior margin of Poupart's ligament in continuity with the fascia iliaca,[154] except opposite the femoral vessels. Here the fascia transversalis descends in front of the femoral vessels[131] forming the anterior, while the fascia iliaca descends behind the vessels forming the posterior wall of the **femoral sheath.** In front of the crural ring it is thickened, forming the **deep crural arch.**

Behind, the fascia is continued over the posterior abdominal wall, becoming ultimately fused with the posterior aponeurosis of the transversalis[156] where it bounds the abdominal cavity in front of the quadratus lumborum and psoas muscles.

Note.—Opposite the umbilicus[4] the fascia transversalis is perforated obliquely by the obliterated umbilical vein,[39] for which it forms a short canal.

26. *Note.*—The **spermatic cord** [24, 27] at the **internal abdominal ring** [25] receives its inner covering,[27] namely, the **infundibuliform or internal spermatic fascia.**

27. *Note.*—**Coverings** of the spermatic cord and testis.[126] The spermatic cord and testis receive their coverings from the musculo-aponeurotic wall.

At the **internal abdominal ring** they receive from the *fascia transversalis* their inner covering, namely, the **infundibuliform or internal spermatic fascia.**[26]

At the **middle abdominal ring** they receive from the *conjoined tendon and obliquus internus muscle* their middle covering, namely, the **cremasteric or middle spermatic fascia.**[22, 24]

At the **external abdominal ring** they receive from the *obliquus externus aponeurosis and deep fascia* their outer covering, namely, the **intercolumnar or external spermatic fascia.**[12, 20]

28. *Note.*—The **inguinal canal** (Canalis inguinalis) is the oblique tunnel through the musculo-aponeurotic wall occupied by the spermatic cord and its coverings.* It begins at the **internal,**[25] passes by way of the **middle,**[23, 21] and ends at the **external** [19, 12] **abdominal ring.** Between entrance and exit the *front wall* of the canal is formed by the obliquus internus and obliquus externus, the *back wall* by the fascia transversalis, conjoined tendon, and the triangular fascia, the *floor* by the ligaments of Poupart and Gimbernat, and the *roof* by the arches of the three abdominal rings.

* For the Female, see Appendix.

29. **VESSELS AND NERVES** OF THE MUSCULO-APONEUROTIC WALL.

Arteries.	Veins.	Lymph Streams.	Nerves (spinal).
1. Superior epigastric.			
Musculophrenic.			
2. Intercostal, 10th and 11th.			Thoracic, 7th to 12th.
Subcostal.			
3. Lumbar.			Lumbar, 1st.
4. Deep circumflex iliac.			
Deep epigastric.			

ARTERIES.

1. Terminal branches of the internal mammary artery.

The **superior epigastric** artery (A. epigastrica superior), or internal terminal branch of the internal mammary artery, enters the rectus sheath [17] between the sternal and costal origins of the diaphragm.[149] Branches—**muscular** and **cutaneous.**[7]

The **musculophrenic** artery (A. musculophrenica), or external terminal branch of the internal mammary artery, piercing the diaphragm and transversalis muscles, enters the abdominal wall opposite the anterior end of the 10th intercostal space and terminates on the superficial aspect of the transversalis.

2. Paired parietal branches of the thoracic aorta.

The **10th and 11th intercostal** arteries, and

The **subcostal** artery [160] (Aa. intercost-

ales X.–XII.) all end in **anterior cutaneous branches** which appear on the anterior and lateral abdominal walls, the former at the anterior end of the corresponding intercostal spaces, the latter from below the 12th rib. They all run on the superficial aspect of the transversalis. Branches—**lateral cutaneous**[7] and **muscular.**

3. Paired parietal branches of the abdominal aorta.

The **lumbar** arteries[160] (Aa. lumbales) run on the superficial aspect of the transversalis, but only the upper two or three reach the lateral wall.

4. Branches of the external iliac artery.[131]

The **deep circumflex iliac** artery[43] (A. circumflexa ilium profunda), a little external to the anterior superior iliac spine, pierces the fascia transversalis and transversalis muscle, on the superficial aspect of which latter it proceeds backwards. Branches—**muscular**, including a large ascending branch, and **cutaneous.**

The **deep epigastric** artery[43] (A. epigastrica inferior) pierces the fascia transversalis at the outer border of the rectus muscle and enters the rectus sheath[17] over the semilunar fold of Douglas. Branches[43]—**muscular** and **cutaneous.**[7]

VEINS, correspond to the arteries.

30. LYMPH STREAMS.

The **superior epigastric** lymph stream accompanies the superior epigastric artery and ascends to the internal mammary *glands.*

The **lumbar** lymph stream is made up of streams which accompany the lumbar arteries and

flow to *glands*[139] on the sides of the aorta. *Glands* are found below the transverse processes of the lumbar vertebræ.

The **deep circumflex iliac** lymph stream accompanies the deep circumflex iliac artery and flows to the external iliac *glands.*[139]

The **deep epigastric** lymph stream accompanies the deep epigastric artery and descends to the external iliac *glands.*[139]

31. NERVES (SPINAL).

(α) **7th to 12th thoracic.**

The **anterior primary divisions** of these nerves divide in the lateral wall of the body, each into an anterior and a lateral branch.

The **anterior branches** all end in the wall of the abdomen, the 7th to 11th piercing the attachment of the diaphragm and transversalis muscles to the costal cartilages, the 12th being abdominal throughout. They enter the rectus sheath[17] either immediately by passing above the posterior lamella of the obliquus internus or by running for some distance superficial to the transversalis and then piercing the same lamella not far from the outer border of the rectus. Branches—**muscular** (to the lateral and anterior muscles) and **anterior cutaneous.**[9]

The **lateral branches.**

The 9th, 10th, and 11th give off **lateral cutaneous**[9] branches which become superficial along the line of interdigitation of the obliquus externus with the serratus magnus and latissimus dorsi muscles.

The 12th gives off **muscular**

branches to the lateral muscles and a **lateral cutaneous or iliac**[9] branch, which descends obliquely through the lateral muscles and becomes superficial about 2 inches behind the anterior superior iliac spine.

(β) **1st lumbar.**

The **anterior primary division** helps to form the lumbar plexus. To the anterior and lateral abdominal walls it gives off two branches.

The **iliohypogastric** nerve[164] (N. iliohypogastricus) runs forward above the iliac crest superficial to the transversalis. Piercing the obliquus internus 1 inch in front of the anterior superior iliac spine and the aponeurosis of the obliquus externus $1\frac{1}{2}$ inches above the external abdominal ring it terminates in its **anterior cutaneous or hypogastric** branch[9] (Ramus cutaneus anterior). It also gives off a small **lateral cutaneous or iliac** branch[9] (Ramus cutaneus lateralis) which, after descending obliquely through the lateral muscles behind the iliac branch of the 12th thoracic nerve, becomes superficial above the iliac crest.

The **ilio-inguinal** nerve[164] (N. ilioinguinalis) follows a similar course below the iliohypogastric, but it pierces the obliquus internus muscle further forward, and it becomes superficial by passing through the external abdominal ring and piercing the intercolumnar fascia to terminate in its **anterior cutaneous or inguinal** branch[9] (Nn. scrotales anteriores).

II.

THE ABDOMINAL CAVITY PROPER.

32. The abdominal cavity proper comprises all that part of the abdomen proper which is within the bounding fascia.[25, 148, 154] It is of great capacity and contains

I. The extraperitoneal connective tissue.
II. The abdominal organs.
III. The peritoneal sac.
Vessels and nerves.

33. I.–II. The **EXTRAPERITONEAL CONNECTIVE TISSUE** (Tela subserosa) is spread over the deep surface of the bounding fascia.[32] Its arrangement is, however, complicated by the presence of the organs. Some of the **ORGANS** lie upon or are embedded in the parietal portion of the tissue, by which part of their surface is directly, though it may be loosely, fixed to the wall. A "*fixed*" *organ* may yet have considerable freedom of movement. Other organs again float and are moored to the wall by visceral processes of the tissue. A "*floating*" *organ* has great freedom of movement. Like the organs, the **VESSELS AND NERVES** lie in the extraperitoneal connective tissue, the parietal passing to and from the walls, the visceral supplying all the contents of the cavity. The two sets of vessels communicate to some extent by anastomosis in the extraperitoneal connective tissue (subperitoneal plexus of Turner). The vessels and nerves of a fixed organ

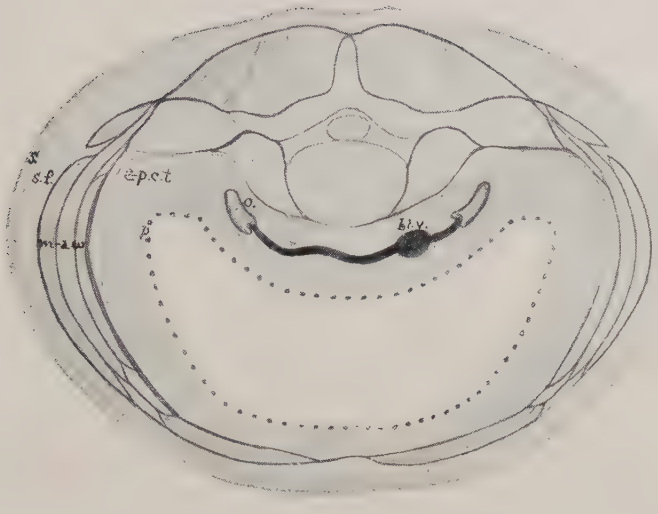


FIG. 1.

The **abdominal wall** consists of—

i. Skin and superficial fascia.

ii. Musculo-aponeurotic wall.

The **abdominal cavity** lies within the musculo-aponeurotic wall.

Fig. 1 is really a transverse section of the abdominal wall opposite the second lumbar vertebra, but is merely intended to show in a general way the constitution of the abdominal wall.

s., skin.

s.f., superficial fascia.

m-a.w., musculo-aponeurotic wall.

N.B.—Figs. 2, 3, 4, and 5 are very diagrammatic.

To face p. 42.

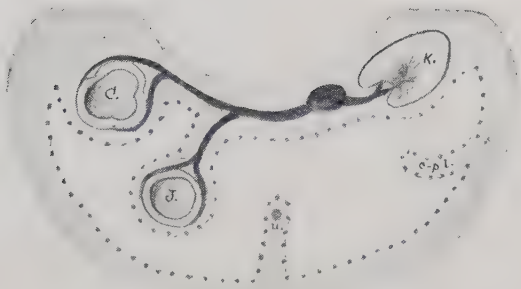


Fig. 3.

Wherever an organ is fixed or moored to the wall, the disposition of the extraperitoneal connective tissue, blood vessels, and peritoneum is modified accordingly, the peritoneum being indented and invaginated into folds. Similar folds are also found either containing structures other than organs, or else due to mere puckering of the peritoneum. The complexity of the peritoneal sac means an increase in its extent, but a decrease in its actual content.

C., colon.
K., kidney.
J., jejuno-ileum.
u., umbilical vein.
c-p.l., colico-phrenic ligament.

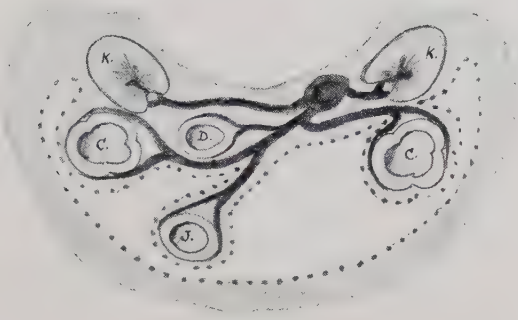


Fig. 4.

Wherever an organ is moored not to the wall, but to some other organ, the disposition of the extraperitoneal connective tissue, blood vessels, and peritoneum is still more complex. This means a great increase in the extent, but a great diminution in the actual content of the peritoneal sac.

K., kidney.
C., colon.
D., duodenum.
J., jejuno-ileum.

FIG. 5.

Fig. 5 shows a very complex condition. The kidney is fixed to the wall, the spleen is moored to the kidney, the stomach is moored to the spleen, and lastly, the common bile-duct, hepatic artery, and portal vein are moored to the stomach.

N.B.—Since the abdominal cavity is in reality closely packed with organs, it follows that the extent of the peritoneal sac is enormous, while its actual content is diminished almost to nothing.

K., kidney.
C., colon.
D., duodenum.
Sp., spleen.
St., stomach.

pass to and fro in the parietal portion of the extraperitoneal connective tissue, those of a floating organ traverse its visceral process also.

34. III. The ***PERITONEAL SAC*** (Peritonæum), a serous membrane, is the central structure of the abdominal cavity. Had there been no abdominal organs and no visceral processes of extraperitoneal connective tissue the peritoneum might merely have lined the parietal portion of the tissue and so have retained the shape of the abdominal cavity. But wherever an organ is fixed to the wall the sac is *indented*, since the peritoneum passes from the wall over the organ, and wherever an organ is moored to the wall the sac is *invaginated*, since the peritoneum passes from the wall over the mooring to invest the organ. But an organ may be fixed not to the wall but to some other fixed organ, or it may be moored not to the wall but to some other organ either floating or fixed. The indentations and invaginations of the sac thus become very complex, so complex indeed that whereas the abdominal cavity is capacious enough to contain the organs the peritoneal sac in spite of its extent is only a *potential space* with its walls everywhere constantly in apposition and containing nothing but a little serous fluid. Its shape varies unceasingly with the continual change in position of the organs, which, owing to the serous membrane, glide with a minimum of friction on each other and on the walls of the abdominal cavity.

35. Owing to the extent and complexity of the peritoneum, subdivision is necessary.

(*a*) **Peritoneal ligaments.**

A peritoneal ligament is any peritoneal attachment of an organ either to another organ or to the walls

or roof of the abdominal cavity. The complete "peritoneal attachment" of an organ consists not only of peritoneum but also of extraperitoneal connective tissue and vessels and nerves. When such a ligament moors an organ its constituents are intimately related to each other, but when the ligament fixes an organ the relation of its constituents is much less intimate, so that the term peritoneal ligament is also applied to the peritoneal constituent of the attachment and even, it may be, to parts of the peritoneal constituent.

All peritoneal ligaments which moor floating portions of intestine to the posterior abdominal wall or to organs which are fixed to that wall are called mesenteries. A mesentery is a sheet of extraperitoneal connective tissue (Lamina mesenterii propria) covered on both sides by peritoneum, which is continuous with that on the wall and also with that covering the intestine. Amid the connective tissue are vessels and nerves for the corresponding portion of intestine. The attachment of the mesentery to the wall is its root or origin, the attachment to the intestine its insertion.

Note.—The term mesentery is also applied to the ligament which moors the appendix [59] to the under surface of the mesentery proper.

Certain peritoneal ligaments which moor either the stomach or the stomach and floating duodenum directly to other organs are called omenta. An omentum is a sheet of extraperitoneal connective tissue covered on both sides by peritoneum, which is continuous with that on the stomach and also with that covering the other organ involved. Amid the connective tissue are vessels and nerves for the stomach.

(*b*) **Minor peritoneal folds and fossæ.** In addition to the ligaments minor peritoneal folds are found in relation to various structures, most of the folds giving rise to corresponding fossæ.

(*c*) **Tunica vaginalis testis.**[128] In the course of development the portion of peritoneum in relation with the testis becomes cut off from the peritoneal sac, after which it persists as a separate serous sac known as the tunica vaginalis testis.

(*See also the Note on the* PERITONEUM *in the Appendix.*)

			Omenta.	Mesenteries.
U.M.	Colon.[57]	Colicophrenic.		Meso-appendix. (Ascending mesocolon). Transverse mesocolon. (Descending mesocolon).
	Jejuno-ileum.[66]			Mesentery proper.
U.C.	Liver.[76-84]	Hepatoparietal. Falciform. Hepatophrenic. Right lateral. Coronary. Left lateral.		
	Stomach.[94-99]	Gastrophrenic. (Gastrorenal). (Gastropancreatic).	Colic. Hepatic. Splenic.	
	Spleen.[104]	Lienorenal.		

Note.—Throughout the work,
U.M. = unpaired organs of the mesenteric compartment.
U.C. = unpaired organs of the cœliac compartment.
P. = paired organs.

(*B*) **Folds.**	**Fossæ.**	
Inguinal.		40
	Femoral.	40
Ileo-appendicular.		59
Ileocolic.		60
	Retrocolic.	60
Duodenal.		65
Paraduodenal.		65
Pancreaticogastric.		114,116

(*C*) **Tunica vaginalis testis.**[128]

A. In relation to the Anterior and Lateral Walls.

37. I. Extraperitoneal connective tissue.
II. Organs.
III. Peritoneum.
Vessels.

38. I. **EXTRAPERITONEAL CONNECTIVE TISSUE** [46] (Tela subserosa).

Above, it is thin and contains little fat, so that the peritoneum is rather firmly adherent.

Below, in the suprapubic region, as in the pelvis, it contains much fat, so that the peritoneum is readily stripped off the anterior abdominal wall by the urinary bladder as it ascends during distension.

39. II. **ORGANS,** etc. Apart from the vasa deferentia[127] these are for the most part relics of fœtal

structures, namely, the intra-abdominal portion of the placental circulation,[4] and of the allantois.[4]

Above, the **obliterated umbilical vein**[40] (Lig. teres hepatis) extends from the umbilicus upwards and to the right to the margin of the liver.

Below, the **urachus** (Lig. umbilicale medium), the relic of the fœtal allantois, extends upwards in the middle line from the apex of the urinary bladder to the umbilicus.

The **obliterated hypogastric arteries** (Lig. umbilicale laterale) extend on each side upwards and inwards from the pelvic brim in front of the iliopectineal eminence to the umbilicus.

The **deep epigastric arteries**[43] (A. epigastrica inferior) run on each side upwards and inwards from Poupart's ligament on the inner side of the internal abdominal ring towards the umbilicus.

40. III. *PERITONEUM.*

Above, the **falciform ligament**[36, 76] (Lig. falciforme hepatis), a sickle-shaped fold of peritoneum, is raised by the obliterated umbilical vein,[39] which, after piercing the fascia transversalis,[25] recedes from the anterior abdominal wall and diaphragm to reach the margin of the liver rather to the right of the middle line.

Below, the peritoneum is raised into five ridges known as the **inguinal folds**,[36] one in the middle line raised by the urachus (Plica umbilicalis media), and two on each side raised by the obliterated hypogastric and deep epigastric arteries (Plica umbilicalis lateralis, Plica epigastrica). There are consequently on each side three depressions in the peritoneum

called the **inguinal fossæ**, the *internal* between the urachus and the obliterated hypogastric artery, the *middle* between the obliterated hypogastric and deep epigastric arteries, and the *external* on the outer side of the deep epigastric artery. The external inguinal fossa (Fovea inguinalis lateralis) lies behind the internal abdominal ring,[25] from which it is separated only by peritoneum and extraperitoneal connective tissue. The middle inguinal fossa (Fovea inguinalis medialis) lies behind the middle inguinal ring,[23, 21] from which it is separated not only by peritoneum and extraperitoneal connective tissue but also by fascia transversalis. The internal inguinal fossa (Fovea supravesicalis) lies behind the external abdominal ring,[19] from which it is separated not only by peritoneum and extraperitoneal connective tissue but also by fascia transversalis and conjoined tendon and, to some extent possibly, by the triangular fascia. All the inguinal fossæ are above the level of Poupart's ligament. The **femoral fossa**[36] is a slight depression in the peritoneum behind Poupart's ligament just internal to the femoral vessels. It corresponds to the crural ring.

41. *Note.*—The **crural ring**, which is at the entrance to the **crural canal**, is bounded in front by Poupart's ligament, behind by the pectineus muscle at its origin from the pubis, internally by Gimbernat's ligament, and externally by the femoral vein. That portion of Poupart's ligament which is in front of the crural ring is known as the **superficial crural arch**, and the corresponding portion of the fascia transversalis as the **deep crural arch.** The crural ring is filled by a plug of extraperitoneal connective tissue called the **septum crurale.**

42. [**Hernia.**—An abdominal hernia consists in the protrusion of a portion of the contents of the abdominal cavity through the musculo-aponeurotic wall.

A. **Inguinal hernia** is—

External,
Middle,
Internal,

according as it originates at the external, middle, or internal inguinal fossa.[40]

i. **With a persistent processus funicularis**[128] communicating with the peritoneal sac, an

External inguinal hernia may descend

(*a*) **Within the processus vaginalis.**

Then, according as the processus funicularis communicates with the tunica vaginalis or not, the hernia will remain

Within the processus funicularis, or will continue to descend and ultimately lie

Within the tunica vaginalis.

If the persistent processus funicularis no longer communicates with the peritoneal sac, the hernia may be found

(*b*) **Invaginating the processus vaginalis.**

Finally, whether the persistent processus vaginalis communicates with the peritoneal sac or not, the hernia may descend

(*c*) **Behind the processus vaginalis.**

ii. **With an obliterated processus funicularis** all inguinal herniæ, whether external, middle, or internal, push before them the peritoneum and extraperitoneal connective tissue, receive three coverings from the musculo-aponeurotic wall, and ultimately lie beneath the superficial fascia and skin of the scrotum.

External inguinal hernia, like the spermatic cord and testis, passes through the whole length of the inguinal canal, receiving at the internal, middle, and external abdominal rings three successive coverings, the internal, middle, and external spermatic fasciæ.[27]

Middle inguinal hernia, after making for itself a covering of fascia transversalis, passes through the middle and external abdominal rings at which it receives two other coverings, the middle and external spermatic fasciæ.

Internal inguinal hernia, after making for itself one covering of fascia transversalis and another of conjoined tendon, and after possibly carrying away some fibres of the triangular fascia, passes through the external abdominal ring, at which it receives its last covering, the external spermatic fascia.

B. **Femoral hernia** originates at the femoral fossa. Pushing before itself the peritoneum and extraperitoneal connective tissue it passes through the crural ring.[41]

C. **Umbilical hernia.**

(*a*) **With an unclosed umbilical ring**[14] a coil of intestine may be found at birth projecting for a short distance into the umbilical cord.

(*b*) **Through a weak umbilical ring** a hernia may find its way in infants and young people.

(*c*) **Through the linea alba** immediately above or below the umbilicus a portion of omentum or intestine sometimes protrudes in adults.]

43. **VESSELS** (PARIETAL).

Arteries.	Veins.	Lymph Streams.	Nerves.
Deep epigastric.			
Deep circumflex iliac.			
	Along the obliterated umbilical vein.		
	Along the urachus.		

ARTERIES.

The **deep epigastric** artery (A. epigastrica inferior) arises from the front of the external iliac artery [131] just above Poupart's ligament. It runs in the extraperitoneal connective tissue, first forwards round the lower limit of the peritoneal sac, then upwards and inwards on the inner side of the internal abdominal ring. It then pierces the fascia transversalis [29] at the outer border of the rectus muscle. Branches — **cremasteric, pubic, muscular,**[17] and **cutaneous.**[17]

The **cremasteric** branch [22] (A. spermatica externa) descends through the inguinal canal and supplies the coverings of the spermatic cord and testis, including the cremaster muscle.

The **pubic** branch (Ramus pubicus) descends on either the outer or the inner side of the crural ring to anastomose with the pubic branch of the obturator artery, itself a branch of the internal iliac artery. Sometimes when the obturator artery is absent the pubic branch of the deep epigastric artery is unusually large and takes its place.

The **deep circumflex iliac** artery (A. circum-

flexa ilium profunda) arises from the front of the external iliac artery [131] just above Poupart's ligament. It runs in the groove formed by the meeting of the fascia transversalis and the fascia iliaca upwards and outwards to the anterior superior iliac spine, a little external to which it pierces [29] the fascia transversalis and transversalis muscle. Branches—**muscular**, including a large ascending branch, and **cutaneous.**[7]

VEINS AND LYMPH STREAMS [29, 30] accompany the arteries and terminate, the former in the external iliac veins,[136] the latter in the external iliac glands.[139] In addition, along the obliterated umbilical vein and along the urachus, the veins (Vv. parumbilicales Sappeyi) and lymphatics of the region of the *umbilicus* communicate above with those of the liver, below with those of the bladder.

44. B. In relation to the Roof of the Abdomen and the Posterior Abdominal Wall.

I. Peritoneum.
II. Extraperitoneal connective tissue.
III. Organs.
Vessels and nerves.

45. I. ***PERITONEUM.*** [34, 36] — The peritoneum is complicated because of the complex arrangement of the organs and visceral processes of extraperitoneal connective tissue. If these are understood the peritoneum itself presents little difficulty.

46. II. **EXTRAPERITONEAL CONNECTIVE TISSUE** [38] (Tela subserosa).

In relation to the **roof** of the abdomen, *i.e.* on the diaphragm, the connective tissue is small in amount and almost devoid of fat, so that the peritoneum is somewhat firmly adherent. The arrangement is complicated only by the falciform ligament.[40]

In relation to the **posterior abdominal wall** the connective tissue varies greatly in amount and character, and it is complicated by the presence of the organs. In the parietal portion fat is abundant, especially beside the kidneys.[124] In the visceral processes also much fat may be present. On the surface of the organs, however, the connective tissue is usually scanty and devoid of fat, the peritoneum being firmly adherent.

47. III. ORGANS, VESSELS, AND NERVES.

Note.—The ***GASTROCOLIC LIGAMENT or COLIC OMENTUM***[36] (Ligamentum gastrocolicum) is a peritoneal ligament which attaches the stomach[97] above to the colon[61] below. It is a sheet of extraperitoneal connective tissue covered on both sides by peritoneum, which is continuous with that on the stomach and also with that covering the colon. Had it passed directly from stomach to colon the omentum would not have been large. It is, however, very extensive, descending into the mesenteric compartment,[48] and being folded so as to form a bag or sac, the mouth of which is directed upwards. The omentum thus consists of an anterior or **gastric portion** and a posterior or **colic portion**. Towards the free margin of the fold the two portions become fused through adhesion and absorption of their apposed peritoneal surfaces.

48. *Note.*—The **transverse colon**[61] stretches from right to left about the level of the subcostal plane and is attached to the posterior abdominal wall at a slightly higher level along the transverse colic line. At each end it is fixed, but the intervening portion being moored by the **transverse mesocolon** floats downwards and forwards to the anterior abdominal wall, from which it is separated only by the colic omentum.[47] The transverse colon and mesocolon thus form a sloping partition, dividing the cavity of the abdomen proper into **two compartments, the cœliac**[73] **above and the mesenteric**[55] **below.** Before the position of the organs is disturbed there are visible in the cœliac compartment the liver and gall-bladder and the stomach, and in the mesenteric compartment the jejuno-ileum and the colon, both of which however are partly concealed by the colic omentum.

49. **CLASSIFICATION OF THE ORGANS ACCORDING TO FUNCTION.**

DIGESTIVE.

Alimentary canal (Tubus digestorius), from the lower end of the œsophagus to the beginning of the pelvic colon.[91-99, 64-66, 56-63]

Accessory glands.

Liver and gall-bladder.[74]

Pancreas.[105]

DUCTLESS GLANDS.

Spleen.[100]

Suprarenal capsules.[121]

URINARY.

Kidneys.[122]

GENERATIVE.

Testes.[126]

50. CLASSIFICATION OF THE ORGANS BY ANOTHER METHOD.

UNPAIRED.

Of the cœliac compartment.[73]

Liver and gall-bladder.[74]

Lower end of the œsophagus, stomach, and supramesocolic portion of the duodenum.[90]

Spleen.[100]

Pancreas.[105]

Of the mesenteric compartment.[55]

Colon above the true pelvis.[56]

Inframesocolic portion of the duodenum, and jejuno-ileum.[64]

PAIRED.[120]

Suprarenal capsules.[121]

Kidneys.[122]

Testes.[126]

51. TOPOGRAPHY OF THE ORGANS IN RELATION TO THE POUPART LINES.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.[73]	Liver and gall-bladder.	Liver and gall-bladder. Stomach and duodenum. Spleen. Pancreas.	Liver? Stomach. Spleen. Pancreas.
P.[120]	Kidney.	Capsules. Kidneys.	Kidney.
U.M.[55]	Colon, transverse. ascending. cæcum. Jejuno-ileum.	Colon, transverse. Duodenum and jejuno-ileum.	Colon, transverse. descending. iliac. Jejuno-ileum.

52. TOPOGRAPHY OF THE ORGANS IN RELATION TO ZONES AND REGIONS.

(Modified from Quain.)

RIGHT HYPOCHONDRIAC.	EPIGASTRIC.	LEFT HYPOCHONDRIAC.	COSTAL ZONE.
The greater part of the right lobe of the **liver.** The hepatic flexure of the **colon.** Part of the right **kidney.**	Part of the right and the greater part or the whole of the left lobe of the **liver,** with the **gall-bladder.** Part of the **stomach,** including both orifices, the first and second parts of the **duodenum,** the duodeno-jejunal flexure, the upper or inner end of the **spleen,** the greater part of the **pancreas.** The **suprarenal capsules** and part of both **kidneys.**	Sometimes a part of the left lobe of the **liver,** part of the **stomach,** with the greater portion of the **spleen,** and the tail of the **pancreas.** The splenic flexure of the **colon.** Part of the left **kidney.**	
Subcostal	*line*	*Subcostal*	
LUMBAR.	UMBILICAL.	LUMBAR.	UMBILICAL ZONE.
The ascending **colon,** sometimes part of the **ileum.** Part of the right **kidney.**	The greater part of the transverse **colon,** the third part of the **duodenum,** some convolutions of the **jejunum** and **ileum.** Part of the right, and sometimes of both **kidneys.**	The descending **colon,** part of the **jejunum.** Sometimes a small part of the left **kidney.**	
Intertubercular	*line*	*Intertubercular*	
ILIAC.	HYPOGASTRIC.	ILIAC.	HYPOGASTRIC ZONE.
The **colon,** *i.e.* cæcum with the vermiform appendix, the termination of the **ileum.**	The convolutions of the **ileum.** (The *pelvic colon* and *rectum*, the *bladder* in children, and when distended in adults also, the *uterus* when gravid.)	The iliac **colon,** (the *pelvic colon*), convolutions of the **jejunum** and **ileum.**	

Right — *Poupart* — *line* — *Poupart* — *Left*

53. VESSELS AND NERVES OF THE ORGANS.

	Arteries.	Veins.	Lymph Streams.	Nerves (Symp. Plexuses).
U.C.[112] U.M.[67]	Cœliac. Superior mesenteric. Inferior mesenteric.	Hepatic.	Cœliac. Superior mesenteric. Inferior mesenteric.	
P.[129]		Suprarenal. Renal. Spermatic.		

54. DISTRIBUTION OF ARTERIES TO THE ORGANS.

ARTERIES.	U.C.							U.M.			P.		
	Liver.	Gall-bladder.	Œsophagus.	Stomach.	Duodenum (Supram).	Spleen.	Pancreas.	Colon.	Duodenum (Infram).	Jejuno-ileum.	Suprarenal Capsules.	Kidneys.	Testes.
Cœliac:[113]													
Coronary—													
Œsophageal			×										
Gastric				×									
Splenic:													
Pancreatic							×						
Splenic						×							
Vasa brevia				×									
Left gastro-epiploic				×									
Hepatic:													
Gastroduodenal—													
Superior pancreatico-duodenal					×		×						
Right gastro-epiploic				×									
Pyloric				×									
Hepatic	×												
Cystic		×											
Superior mesenteric:[68]													
Inferior pancreaticoduodenal							×		×	×			
Enteric or vasa intestini tenuis										×			
Ileocolic								×					
Right colic								×					
Middle colic								×					
Inferior mesenteric:[69]													
Left colic								×					
Sigmoid								×					
Suprarenal[129]											×		
Renal												×	
Spermatic													×

I.

Unpaired Organs of the Mesenteric Compartment.[50]

55. The **mesenteric compartment** occupies the **umbilical and hypogastric zones.** Its roof is formed by the transverse colon and mesocolon.[48] From the transverse colon, which rests against the anterior abdominal wall about the level of the subcostal plane, the mesocolon slopes upwards and backwards to the posterior abdominal wall along the transverse colic line. Consequently, the lower and posterior portion of the costal zone belongs not to the cœliac[73] but to the mesenteric compartment.

External differences between the large and the small intestine are seen in the calibre, in the length, in the distribution of the longitudinal muscle (bands, sacculations), in the peritoneum (appendices epiploicæ), and in the mesenteric attachment.

Colon.

56. The **Colon** or large intestine (Intestinum crassum) almost completes a circuit round the mesenteric compartment. Beginning[51, 52] on the right side in the iliac, it ascends through the lumbar into the hypochondriac region, where beside the liver it takes its first, the **hepatic flexure.** Turning to the left, it descends into the umbilical and then reascends into the left hypochondriac region, where at its highest level beside the spleen it takes its second, the **splenic flexure.** Lastly, descending on the left side from the hypochondriac through the lumbar into the iliac region, it dips over the pelvic brim into the true pelvis. For

convenience, the colon is divided into **cæcum, ascending colon, transverse colon, descending colon, and iliac colon** in the abdomen proper, and *pelvic colon* and *rectum* in the pelvis.

Note.—The hepatic and splenic flexures are not portions of the colon, but merely the bends between the ascending and transverse and between the transverse and descending colon. It is convenient, however, to apply the terms to the colon in the neighbourhood of the actual flexures.

57. ***PERITONEUM*** [36] of the colon.

(α) 1. The **cæcum** bulges from the lower end of the ascending colon and is completely covered by peritoneum.

The **ascending colon** is usually fixed, although it sometimes has a mesocolon. If it be removed, the posterior abdominal wall is bared of peritoneum along what may be called the **ascending colic line.**

2. The **transverse colon** is fixed at its beginning and end, but in its intervening portion it is moored by the transverse mesocolon.[61] It is attached in its whole length along the **transverse colic line.**

3. The **descending colon and iliac colon** are usually fixed along the **descending colic line.**

4. The *pelvic colon* is moored to the brim and wall of the true pelvis, but its coils float upwards into the abdomen proper. The *rectum* in its upper two-thirds is fixed, in its lower third it is not in relation with the peritoneum at all.

(β) The **colicophrenic ligament** [61] attaches the colon beside the splenic flexure to the diaphragm opposite the 10th or 11th rib in the mid-axillary line.

Since it helps to support the spleen, this ligament is also called the **sustentaculum lienis.**[100]

Note.—The colic lines form three sides of what may be termed the **colic square.**

Arteries of the colon.[54]

58. **VISCERAL RELATIONS** OF THE COLON.

The colon comes into relation with all the organs of the abdomen proper except the suprarenal capsules and the testes,—below with the jejuno-ileum,[66] above with the liver[87] and gall-bladder,[88] stomach[97] and spleen,[102] and behind with the right kidney,[123] duodenum,[65, 93] pancreas,[105] and left kidney.[123]

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.	Liver and gall-bladder.	Liver and gall-bladder. Stomach and duodenum. Pancreas.	Stomach. Spleen. Pancreas.
P.	Kidney.		Kidney.
U.M.	Jejuno-ileum.	Duodenum and jejuno-ileum.	Jejuno-ileum.

59. The **cæcum** (Intestinum cæcum) lies[51, 52] for the most part external to the right Poupart line in the iliac region and is more or less overlapped by jejuno-ileum.[66] It bulges from the lower end of the ascending colon and is completely covered by ***PERITONEUM***, resting behind on the iliopsoas muscle.[157] The ileum pours its contents through

The **ileocæcal valve** (Valvula coli) into the cæcum on its inner and hinder aspect opposite the point of intersection of the intertubercular and right Poupart lines.

The **vermiform appendix** (Processus vermiformis) opens into the cæcum on its inner and hinder aspect below the ileocæcal valve. It is directed (*a*) over the true brim into the pelvis, or (*b*) upwards behind the cæcum, or (*c*) upwards and inwards towards the spleen. It is covered by ***PERITONEUM*** except where it is attached to the **meso-appendix** [36] (Mesenteriolum processus vermiformis), by which it is moored to the under surface of the portion of the mesentery proper [66] belonging to the terminal part of the ileum. From the ileum to the front of the meso-appendix stretches the **ileo-appendicular fold** of peritoneum, behind which lies the **ileo-appendicular fossa.**[36]

VISCERAL RELATIONS OF THE CÆCUM.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.M.	Colon, ascending. Jejuno-ileum.	Jejuno-ileum.	

60. The **ascending colon** (Colon ascendens) ascends from the cæcum external to the right Poupart line,[51, 52] through the lumbar into the hypochondriac region, and it terminates beside the liver,[87] where the colon takes its first, the hepatic flexure (Flexura coli dextra). Although it occasionally has a mesentery it is usually ***FIXED*** behind along the **ascending colic line** to the

iliacus and quadratus lumborum muscles[157] and to the outer part of the right kidney,[123] its inner surface being in relation with the psoas muscle. Between the ileum and the ascending colon stretches the **ileocolic fold** of peritoneum, behind which is the **ileocolic fossa.**[36] **Retrocolic fossæ** may also be present.

VISCERAL RELATIONS OF THE ASCENDING COLON.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.	Liver.		
P.	Kidney.		
U.M.	Colon, transverse. cæcum. Jejuno-ileum.		

61. The **transverse colon** (Colon transversum) begins at the hepatic flexure in the right hypochondrium,[51, 52] descends into the umbilical region, and reascends into the left hypochondrium, where the colon, at its highest level beside the spleen, takes its second, the splenic flexure (Flexura coli sinistra). From right to left the transverse colon lies between the jejuno-ileum[66] below, and the liver[87] and gall-bladder,[88] stomach,[97] and spleen[100] above. Behind, it is attached along the **transverse colic line**, which runs with a slight upward obliquity over the right kidney,[123] duodenum,[65, 93] and pancreas.[105] At its beginning it is usually fixed to the right kidney, the second part of the duodenum, and perhaps the head of the pancreas. It is then moored by the transverse

mesocolon to the head and along the anterior border of the body of the pancreas. Finally, it is fixed to the tail of the pancreas. Along with its mesocolon, it forms [48] a sloping floor for the cœliac and roof for the mesenteric compartment, so that it comes into relation with most of the abdominal organs.

The ***TRANSVERSE MESOCOLON*** [36] (Mesocolon transversum) is a peritoneal ligament which moors the floating portion of the transverse colon along the transverse colic line to organs which are fixed to the posterior abdominal wall. It is a sheet of extra-peritoneal connective tissue covered on both sides by peritoneum, which is continuous with that on the posterior abdominal wall and also with that covering the colon. But the peritoneum which covers the colon is continuous by way of the colic omentum [47, 97] with that which covers the stomach.

At the **transverse colic line.**

The **peritoneum from the posterior wall of the mesenteric compartment** passes over * the postero-inferior surface of the mesocolon to the transverse colon, after partially encircling which it is continued over the posterior surface of the colic and anterior surface of the gastric portion of the colic omentum to reach the superior surface of the stomach.

The **peritoneum from the posterior wall of the cœliac compartment** passes over the antero-superior surface of the mesocolon to the transverse colon, after partially encircling which it is continued over the anterior surface of the colic and posterior surface of the gastric portion of the colic omentum to reach the inferior surface of the stomach.

* The peritoneum covers, yet forms part of the mesocolon, just as the skin covers, yet forms part of the body.

Note.—The stomach is thus moored directly to the transverse colon by the colic omentum and indirectly to the pancreas along the transverse colic line by what may be called the **gastropancreatic ligament.**[36, 97]

The ***COLICOPHRENIC LIGAMENT*** [36, 57] (Lig. phrenicocolicum).

VISCERAL RELATIONS OF THE TRANSVERSE COLON.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.	Liver and gall-bladder.	Liver and gall-bladder.	
		Stomach and duodenum.	Stomach.
			Spleen.
		Pancreas.	Pancreas.
P.	Kidney.		
U.M.	Colon, ascending.		Colon, descending.
	Jejuno-ileum.	Duodenum and jejuno-ileum.	Jejuno-ileum.

62. The **descending colon** (Colon descendens) beginning at the splenic flexure descends external to the left Poupart line,[51, 52] from the hypochondriac into the lumbar region as far as the iliac crest. Although it occasionally has a mesentery it is usually ***FIXED*** behind along the **descending colic line** to the outer part of the left kidney,[123] and to the quadratus lumborum muscle,[157] its inner surface being in relation with the psoas.

VISCERAL RELATIONS OF THE DESCENDING COLON.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.			Spleen. Pancreas.
P.			Kidney.
U.M.			Colon, transverse. iliac. Jejuno-ileum.

63. The **iliac colon** lies external to the left Poupart line.[51, 52] Beginning at the crest of the ilium in the lumbar region it passes downwards and somewhat inwards through the iliac region as far as the inner border of the psoas, over which it dips into the pelvis to become the pelvic colon. Behind, it is usually ***FIXED*** along the lower part of the **descending colic line** to the iliopsoas muscle.[157] In front, it is usually overlapped by the jejuno-ileum,[66] but may come into direct contact with the peritoneum of the anterior abdominal wall.

VISCERAL RELATIONS OF THE ILIAC COLON.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.M.			Colon, descending. Jejuno-ileum.

64. Inframesocolic portion of the Duodenum, and Jejuno-ileum.

65. The **Inframesocolic portion of the duodenum** (Id.) lies between the Poupart lines,[51, 52] in the mesenteric compartment. It begins and it also ends in the epigastrium, but the intervening part lies within the umbilical region. Beginning at the transverse colic line where the duodenum,[93] descending in front of the right kidney,[123] is crossed by the transverse colon,[61] it curls round the head[106] and ends below the body[108] of the pancreas by becoming continuous at the duodenojejunal flexure (Flexura duodenojejunalis) with the jejuno-ileum.[66]

(Pars descendens).—From the transverse colic line the duodenum, lying in a groove on the right side of the head[106] of the pancreas, descends in front of the inner border of the right kidney[123] and outer aspect of the inferior vena cava and also in front of the right psoas muscle.[157]

(Pars inferior).—It then turns to the left (Pars horizontalis), passing below and to some extent behind the head[106] of the pancreas and lying in front of the inferior vena cava, by which it is pushed forwards into an anterior plane. Finally, it ascends (Pars ascendens) more or less obliquely on the left side of the head of the pancreas lying in front of the aorta and the left psoas muscle. It is for the most part overlapped by jejuno-ileum.[66]

PERITONEUM of the inframesocolic portion of the duodenum.

Fixed on its concave side and also behind, it is elsewhere covered by peritoneum except where it is crossed by the enteric line.[66]

From the terminal portion of the duodenum two folds of peritoneum pass towards the left to the abdominal wall. These are the **superior and inferior duodenal folds,**[36] and behind them lie the **superior and inferior duodenal fossæ,** the mouths of which look downwards and upwards respectively.

The *inferior mesenteric vein,*[70] as it ascends some distance to the left of the terminal portion of the duodenum and curves inwards above the duodenojejunal flexure, raises the **paraduodenal fold** of peritoneum, which bounds the **paraduodenal fossa.**[36]

Arteries of the (inframesocolic portion of the) duodenum.[54]

Suspensory muscle of the duodenum and mesentery proper.[66]

VISCERAL RELATIONS OF THE INFRAMESOCOLIC PORTION OF THE DUODENUM.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.		Duodenum.* Pancreas.*	
P.		Kidney.	
U.M.	Colon, ascending.(?)	Colon, transverse. Jejuno-ileum.	

* Duodenum—supramesocolic portion. Pancreas—in the mesenteric compartment.

66. The **Jejuno-ileum** (Intestinum tenue mesenteriale) may be found in all the nine regions[51, 52] of the abdominal cavity. It extends from the duodenojejunal

flexure (Flexura duodenojejunalis) to the ileocæcal junction. Encircuited by the colon [56] it lies within the colic square, but tends to overflow its boundaries. Near the transverse colic line its coils are in relation with the right kidney,[123] inframesocolic portion of the duodenum,[65] pancreas,[105] and left kidney. It is moored by the mesentery proper along the **enteric line**, which descends obliquely from the duodenojejunal flexure in front of the duodenum, aorta, inferior vena cava, right ureter, and right psoas muscle to the right iliac fossa.

The ***MESENTERY PROPER*** [36] (Mesenterium) is a peritoneal ligament, which moors the jejuno-ileum to the posterior abdominal wall along the enteric line. It is a sheet of extraperitoneal connective tissue (Lamina propria mesenterii) covered on both sides by peritoneum, which is continuous with that on the wall and also with that covering the intestine.

At the **enteric line** the peritoneum passes on each side from the wall of the mesenteric compartment over the one surface of the mesentery towards the jejuno-ileum, after completely encircling which it returns over the other surface of the mesentery to the enteric line and the wall once more. At its root or origin (Radix) the mesentery is plane, but not far from the root it is thrown into large wavy primary folds, each of which develops numerous small secondary folds along the edge of which finally the bowel is attached. This arrangement of the mesentery corresponds with primary and secondary convolutions of the jejuno-ileum, with the result that even when the mesentery is tense no part of the jejuno-ileum can float more than a few inches from the posterior

abdominal wall, although the jejuno-ileum measures 23 feet whereas the enteric line is only 6 inches in length. The mesentery proper divides the mesenteric compartment into a right or **superior mesenteric** and a left or **inferior mesenteric compartment.**

The **suspensory muscle of the duodenum and mesentery proper** (M. suspensorius duodeni) is a thin band of involuntary muscle fibres which is attached above to the diaphragm on the right of the œsophageal opening, descends on the left of the cœliac artery, and is inserted into the duodenojejunal flexure, and the root of the mesentery proper.

Arteries of the jejuno-ileum.[54]

VISCERAL RELATIONS OF THE JEJUNO-ILEUM.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.	Liver (?)	Pancreas.*	
P.	Kidney (?)	Kidney.	Kidney.
U.M.	Colon, transverse. ascending. cæcum.	Colon, transverse. Duodenum.	Colon, transverse. descending. iliac.

* In the mesenteric compartment.

67. **VESSELS AND NERVES** OF THE UNPAIRED ORGANS OF THE MESENTERIC COMPARTMENT.

The **mesenteric territory** comprises the unpaired organs[50] of the mesenteric compartment. It also includes the inframesocolic portion of the pancreas.[105]

The **superior mesenteric territory** comprises

the unpaired organs of the superior mesenteric compartment,[66] namely—

Inframesocolic portion of the duodenum.
Jejuno-ileum.
Colon, almost to the splenic flexure.

The **inferior mesenteric territory** comprises the unpaired organs of the inferior mesenteric compartment, namely—

Colon, from a point just short of the splenic flexure as far as the pelvic brim.

68. ARTERIES.

The **superior mesenteric** artery (A. mesenterica superior) is the second unpaired-visceral branch[132] of the abdominal aorta. It arises from the front of the aorta behind the neck of the *pancreas* and descends in front of the lower part of the head of the pancreas and the third part of the duodenum to the enteric line. Entering the mesentery proper it proceeds towards the right iliac fossa in a curve the convexity of which is towards the intestine, and it ends by supplying the ileum towards but not so far as its termination. It marks the limit of the plane portion of the mesentery. Its branches are as follow :—

i. *In its course as far as the enteric line.*

The **inferior pancreaticoduodenal** artery (A. Pancreaticoduodenalis inferior) arises either directly from the main trunk or more commonly from the first enteric branch and passes behind the head of the *pancreas*, between which and the duodenum it anastomoses with the superior pancreaticoduodenal artery of the cœliac compartment so as to form a loop. To the front of the head of the pancreas it

gives a small branch, which is accompanied by the inferior pancreaticoduodenal *vein*.

The **middle colic** artery (*v.* inf.).

ii. *In the mesentery proper.*

(*a*) *From its convexity.*

The **enteric branches or vasa intestini tenuis** (Aa. jejunales et ileæ) form primary loops in the primary mesenteric folds, and in the secondary folds secondary and lesser loops, from which, finally, straight twigs run direct to the jejuno-ileum.

(*b*) The **terminal branch** supplies the ileum towards but not so far as its termination, forming loops with the lowest of the vasa intestini tenuis and with the ileocolic artery.

(*c*) *From its concavity.*

The **ileocolic** artery (A. ileocolica) supplies the termination of the ileum, the cæcum and appendix, and the beginning of the ascending colon, forming loops with the terminal branch of the main trunk and with the right colic artery. Its branches are—

Ileal.

Anterior cæcal,—in the ileocolic fold.

Posterior cæcal.

Appendicular (A. appendicularis),—behind the terminal portion of the ileum and along the free edge of the meso-appendix.

Colic.

The **right colic** artery (A. colica dextra) arises either directly from the main trunk or more commonly from the ileocolic or the middle colic

artery and supplies the ascending and the beginning of the transverse colon, forming loops with the ileocolic and middle colic arteries.

The **middle colic** artery (A. colica media) arises from the main trunk just before it enters the mesentery proper. Ascending in front of the *pancreas* to the transverse colic line it descends in the transverse mesocolon to supply the transverse colon. It forms a short loop with the right and a very long loop with the left colic artery.

69. The **inferior mesenteric** artery (A. mesenterica inferior) is the third unpaired-visceral branch [132] of the abdominal aorta, from the front and towards the left side of which it arises behind the duodenum some distance below the pancreas. Descending to the pelvic brim it enters the pelvic mesocolon as the *superior hæmorrhoidal* artery (A. hæmorrhoidalis superior). Near its origin it gives off from its left side

The **left colic** artery (A. colica sinistra), which passes outwards and upwards to supply the end of the transverse and the descending colon, forming loops with the middle colic and the highest sigmoid artery. Its ascending branch crosses in front of the lower part of the left kidney and enters the transverse mesocolon.

The **sigmoid** arteries (Aa. sigmoideæ), one to four in number, pass outwards and downwards to supply the lower end of the descending, the iliac, and part of the pelvic colon, forming loops with the left colic artery and with each other.

70. VEINS.

The **superior mesenteric** vein (V. mesenterica superior).

The *tributaries* correspond to the branches of the superior mesenteric artery, but the vein also receives the **right gastro-epiploic** vein[117] (V. gastro-epiploica dextra) of the cœliac compartment).

The *trunk* at first runs in the mesentery proper between the arterial trunk and the enteric line, then lying on the right side of the artery it ascends in front of the duodenum and disappears behind the neck of the *pancreas* where it *joins the splenic to form the portal vein.*[117]

The **inferior mesenteric** vein (V. mesenterica inferior).

The *tributaries* correspond to the branches of the inferior mesenteric artery.

The *trunk* at first runs on the left side of the arterial trunk, then leaving the artery it ascends to the left of the terminal portion of the duodenum, and curves inwards above the duodenojejunal flexure to disappear behind the body of the *pancreas* where it *joins the splenic vein.*

Note.—The inferior mesenteric vein gives rise to the **paraduodenal fold and fossa.**[36, 65]

71. LYMPH STREAMS.

The **superior mesenteric** lymph stream drains the superior mesenteric territory into the superior mesenteric *glands* [139] which lie around the trunk of the superior mesenteric artery and in front of the aorta. *Glands* are found in relation with the branches of the artery as follow :—

In the inferior pancreaticoduodenal territory—(*a*) in front of and (*b*) behind the pancreas.

In the enteric territory—(*a*) beside the intestine and among the secondary and lesser arterial

loops, (*b*) beside the primary arterial loops, (*c*) along the enteric branches.

In the ileocolic territory—(*a*) in front of the cæcum, (*b*) behind the cæcum, (*c*) in the meso-appendix and behind the terminal portion of the ileum, (*d*) along the trunk of the ileocolic artery.

In the right and middle colic territories—(*a*) on the wall of the colon, (*b*) near the colon beside the arterial loops, (*c*) along the right and middle colic arteries.

The **inferior mesenteric** lymph stream drains the inferior mesenteric territory partly into the inferior mesenteric *glands* which lie around the trunk of the inferior mesenteric artery and in front of the aorta, and partly into *glands* on each side of the aorta. *Glands* are found (*a*) on the wall of the colon, (*b*) near the colon beside the arterial loops, (*c*) along the left colic and sigmoid arteries.

72. NERVES (offshoots of the aortic sympathetic plexus [143]).

The **superior mesenteric** sympathetic plexus (Plexus mesentericus superior) accompanies the superior mesenteric artery, along the branches of which it sends offshoots.

The **inferior mesenteric** sympathetic plexus (Plexus mesentericus inferior) accompanies the inferior mesenteric artery, along the branches of which it sends offshoots.

Note.—**Distribution of the arterial supply to the unpaired viscera of the mesenteric compartment.**[54]

II.

Unpaired Organs of the Cœliac Compartment.[50]

73. The **cœliac** compartment occupies the **costal zone.** Except in the subcostal triangle, where it is bounded by the anterior abdominal wall, its roof and walls are formed by the diaphragm. The floor is formed by the transverse colon and mesocolon.[48] From the transverse colon, which rests against the anterior abdominal wall about the level of the subcostal plane, the mesocolon slopes upwards and backwards to the posterior abdominal wall along the transverse colic line. Consequently the lower and posterior portion of the costal zone belongs to the mesenteric compartment.[55]

74. Liver and Gall-bladder.

The **Liver** (Hepar) occupies the right hypochondrium and rather more than the right upper half of the epigastrium, usually descending below the subcostal and not infrequently crossing the left Poupart plane.[51, 52] It has two surfaces, parietal and visceral, and a dividing margin or border (cf. Spleen [100]). The liver is attached to the parietes by the hepatoparietal ligament, and to the stomach by the hepatic omentum.

75. The **parietal surface** is moulded by the walls of the cœliac compartment so as to be divisible into four areas—right, anterior, superior, posterior. It is for the most part ***FIXED*** to the diaphragm by the hepatophrenic ligament.

The **posterior parietal area**[78] (Facies posterior) is for the most part non-peritoneal, since by this surface the liver is fixed to the diaphragm.

76. The **right, anterior, and superior parietal areas** (Facies superior) as well as the visceral surface are almost completely covered by peritoneum.

The ***PERITONEUM*** **from the anterior abdominal wall** [40] runs on the diaphragm [46] as far as the right and superior limits of the posterior parietal area, where it is *reflected to the liver*, passing downwards and forwards *to the margin in front and on the sides.*[79] This, the upper layer of the hepatophrenic ligament, is complicated by the **falciform ligament,**[36, 40] the sickle-shaped fold which is raised by the obliterated umbilical vein [40] in its passage from the umbilicus to the liver margin. The falciform ligament is attached in front and above to the anterior abdominal wall and diaphragm, below and behind to the superior and anterior parietal areas of the liver. In the free border between the umbilicus and the liver margin the *obliterated umbilical vein* can be felt as a firm cord, on which account it is called the *ligamentum teres or round ligament* of the liver. The falciform ligament divides the upper layer of the hepatophrenic ligament into two parts—on the right the continuous **upper layer of the right lateral and coronary ligaments,** on the left the **upper layer of the coronary and left lateral ligaments.** The falciform ligament correspondingly marks on the superior and anterior parietal areas the division of the liver into **right and left lobes.**

77. The **visceral surface** (Facies inferior) is moulded by the organs which rest against it.

78. On the visceral surface and **posterior parietal area** the division into **right and left lobes** is marked by the **longitudinal fissure** which lodges [117] the *obliterated umbilical vein* [40] and its continuation the *obliterated ductus venosus.*

On the **visceral surface** the liver is divided by the **umbilical fissure**, *i.e.* the anterior, horizontal portion of the longitudinal fissure, into *right and left lobes*; the right lobe is incompletely divided by the **fissure for the gall-bladder** [88] into an *interfissural area* and a *right area*; and, finally, the interfissural area is divided by the **transverse or portal fissure** into the *quadrate and caudate lobes.* The caudate lobe separates the transverse fissure from the fissure for the inferior vena cava, thus connecting the lower end of the Spigelian lobe with the right area of the visceral surface.

On the **posterior parietal area** the liver is divided by the **fissure for the ductus venosus**, *i.e.* the posterior, vertical portion of the longitudinal fissure into *right and left lobes*, and the right lobe is divided by the **fissure for the inferior vena cava** into an *interfissural area or Spigelian lobe* and a *right or "non-peritoneal area."*

79. The ***PERITONEUM***, which has been traced [76] **from the anterior abdominal wall** as far as the liver margin in front and on the sides, may now be **traced onwards** over the visceral surface.

80. **Right Lobe.**—Over the right area the peritoneum runs backwards to the liver margin [85] behind, *i.e.* to the inferior limit of the posterior parietal area, where it is reflected to the diaphragm, right kidney,[122] and right suprarenal capsule,[121] forming part of the **lower layer of the coronary ligament.**[36] Beyond the liver on the right the upper and lower layers of the coronary ligament become applied to each other to form the small **right lateral ligament.**[36]

81. Beside the fissure for the gall-bladder the peritoneum passes over the gall-bladder,[88] which is usually fixed but occasionally has a mooring.

82. Over the interfissural area the peritoneum covers the quadrate lobe. Beside the transverse fissure and fissure for the ductus venosus it is reflected over the anterior surface of the **hepatic omentum** [36, 89] to the superior surface of the stomach. (83). From the inferior surface of the stomach another layer of peritoneum ascends over the posterior surface of the hepatic omentum to the transverse fissure and fissure for the ductus venosus, beside which it is reflected over the caudate and Spigelian lobes. Over the caudate lobe it is continuous with the peritoneum of the right area of the visceral surface. Behind the caudate lobe and at the right and upper limits of the Spigelian lobe it is reflected over the inferior vena cava and diaphragm, completing the **lower layer of the coronary ligament.**[36]

84. **Left Lobe.**—The peritoneum runs over the visceral surface and, becoming applied to the upper, itself forms the **lower layer of the left lateral ligament** [36] and so reaches the diaphragm.

85. The **dividing margin or border** of the liver is sharp in front (Margo anterior) and on the sides; behind, it is not so well defined, but it passes below the non-peritoneal area and Spigelian lobe and ascends along the fissure for the ductus venosus, beyond which it practically coincides with the narrow posterior parietal portion of the left lobe.

86. **Lobes** of the liver: [76–78]

Right	(Lobus hepatis dexter.
Quadrate . . .	Lobus quadratus.
	Lobus caudatus Spigelii.
Caudate . . .	Processus caudatus.
Spigelian . . .	Processus papillaris.
Left	Lobus hepatis sinister).

Fissures of the liver :[76-78]

Longitudinal . . .	(Fossa sagittalis sinistra.
Umbilical . . .	Fossa venæ umbilicalis.
For the ductus venosus .	Fossa ductus venosi.
	Fossæ sagittales dextræ.
For the gall-bladder . .	Fossa vesicæ felleæ.
For the inferior vena cava .	Fossa venæ cavæ.
Transverse	Porta hepatis).

Ligaments of the liver :

Round ligament [76] . .	(Lig. teres hepatis.
Peritoneal ligaments :[36, 76-84]	
i. Hepatoparietal—	
Falciform . .	Lig. falciforme hepatis.
Hepatophrenic—	
Right lateral .	Lig. triangulare dextrum.
Coronary . .	Lig. coronarium hepatis.
Left lateral .	Lig. triangulare sinistrum.
ii. Hepatogastroduodenal = hepatic omentum.	Omentum minus).

VESSELS AND NERVES OF THE LIVER AND GALL-BLADDER.[116-118]

ARTERIES

Hepatic.
Cystic.

VEINS.

Portal.
Cystic.
Hepatic.

LYMPH STREAMS.

i. Hepatic,[116] by way of the hepatic omentum along the common bile duct and the trunk of the hepatic artery.

ii. By way of the falciform ligament —in front to the anterior abdominal wall, behind towards the foramen quadratum.

iii. By way of the right lateral, coronary, and left lateral ligaments—to the cœliac *glands*, towards the foramen quadratum, and to the *glands* beside the cardia of the stomach.

NERVES.

Hepatic sympathetic plexus.
Left pneumogastric nerve.

87. **VISCERAL RELATIONS** OF THE LIVER.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.	Gall-bladder.	Gall-bladder. Œsophagus, stomach, and duodenum.	Stomach. Spleen (?)
P.	Kidney.	Capsule. Kidney.	
U.M.	Colon, transverse. ascending. Jejuno-ileum (?)	Colon, transverse.	

Note.—

U.C. The **gall-bladder** [88] is usually fixed along its *fissure* (Fossa vesicæ felleæ).

The **œsophagus** [91] lies behind but not actually in the *œsophageal impression* (Impressio œsophagea) on the back of the left lobe below the left lateral

ligament. The impression is caused not by the œsophagus but by the right lip of the œsophageal opening in the diaphragm.[150]

The **stomach.**[92]—The superior surface causes the *gastric impression* (Impressio gastrica) on the visceral surface of the left lobe. Absence of pressure beside the lesser curvature gives rise to the *omental tuberosity* (Tuber omentale). The pylorus rests beside the umbilical fissure.

The **duodenum**[93] rests in its first part against the *quadrate lobe*, in its second against the *duodenal impression* (Impressio duodenalis) on the right area of the visceral surface.

P. The **right suprarenal capsule**[121] causes the *suprarenal impression* (Impressio suprarenalis) on the non-peritoneal area.

The **right kidney**[123] causes the *renal impression* (Impressio renalis) on the right area of the visceral surface external to the duodenal impression.

U.M. The **colon**[60, 61] beside the hepatic flexure causes the *colic impression* (Impressio colica) on the right area of the visceral surface in front of and below the renal and duodenal impressions.

Note.—The above description of the relations of the stomach and duodenum to the liver holds so long as the stomach is empty. If the stomach be distended, the pylorus pushes its way to the right so as to rest against the quadrate lobe, and the duodenum then passes directly backwards to the neck of the gall-bladder and the duodenal impression.

88. Gall-bladder and bile-ducts.

(*a*) **Hepatic ducts.**—Two or more *terminal tributary* hepatic ducts emerging into the transverse

fissure unite to form the *main* hepatic duct (Ductus hepaticus), which is soon joined by the cystic duct to form the common bile-duct.

(*b*) **Gall-bladder and cystic duct.**

The **gall-bladder** (Vesica fellea), which is pear-shaped, is usually fixed along its fissure to the visceral surface of the liver.[87] The fundus (Fundus v. f.) rests against the anterior abdominal wall above the transverse colon [61] where the costal margin is intersected by the right Poupart line. It is covered by ***PERITONEUM*** and sometimes lies in a notch on the liver margin. The body (Corpus v. f.) is usually fixed to the liver above so that its upper surface is non-peritoneal. It may, however, be moored by a ligament. It is directed upwards, backwards, and to the left, to the neck which is narrow and curved to form a kind of S, terminating in the cystic duct. The neck of the gall-bladder (Collum v. f.) lies above the duodenum [93] at the limit between its first and second parts.

The **cystic duct** (Ductus cysticus), passing downwards and inwards, joins the main or the right terminal tributary hepatic duct to form the common bile-duct.

(*c*) **Common bile-duct** (Ductus choledochus). The common bile-duct descends from the transverse fissure along the free margin of the hepatic omentum [89] to the duodenum.[93] Passing behind the first and then between the pancreas and the second part of the duodenum it joins company with the *pancreatic duct*,[106, 110] and the two ducts piercing obliquely the inner wall of the second part about its middle open by a common orifice on the **biliary papilla**. The orifice is smaller than either duct. The common

lumen immediately preceding the orifice is relatively wide and is known as the **ampulla of Vater.**

Note.—In the hepatic omentum[89] the *common bile-duct* is to the right, the *hepatic artery*[116] to the left, and the *portal vein*[117] behind the other two.

VISCERAL RELATIONS OF THE GALL-BLADDER.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.	Liver.	Liver. Duodenum.*	
U.M.	Colon, transverse.	Colon, transverse.	

* First and second parts.

89. ***HEPATOGASTRODUODENAL LIGAMENT OR HEPATIC OMENTUM***[36] (Omentum minus).

This, the **lesser gastric mooring,**[94] attaches the **lesser curvature of the stomach and the floating duodenum** to the liver and diaphragm along the **lesser gastric line,**—to the liver[82] along the transverse fissure and fissure for the ductus venosus, to the diaphragm in the interval between the fissure for the ductus venosus and the cardia[92] or œsophageal orifice of the stomach. Between the duodenum and the transverse fissure the mooring has a right **free margin** containing the common bile-duct.[88]

At the **lesser gastric line**

The **peritoneum,**[79, 82] **derived from the anterior abdominal wall,** passes over the anterior surface of the hepatic omentum to the superior surface of the

stomach, and then by way of the gastropancreatic ligament [36, 61, 97] to the transverse colic line, whence it descends over the posterior wall of the mesenteric compartment.

The **peritoneum derived from the posterior abdominal wall** passes over the posterior surface of the hepatic omentum to the inferior surface of the stomach and then by way of the gastropancreatic ligament to the transverse colic line, whence it ascends over the posterior wall of the cœliac compartment.

The peritoneum is continuous over the **free margin** of the ligament.

90. Lower end of the Œsophagus, Stomach and Supramesocolic portion of the Duodenum.

91. The **Œsophagus** (Id., pars abdominalis) enters the abdominal cavity through the œsophageal opening [150] in the diaphragm below the left lateral ligament [76, 84] of the liver, slightly to the left of the fissure for the ductus venosus.[78] It descends behind but not in contact with the *œsophageal impression* [87] on the left lobe of the liver, and joins the stomach at the **œsophageal orifice or cardia** (Id.). It is covered by ***PERITONEUM*** in front and on the left side.

92. The **Stomach** (Ventriculus) lies in the left lower half of the epigastrium and in the left hypochondrium. The cardia and pylorus, however, both lie above and to the right of the diagonal of the epigastrium.[51, 52]

The **superior surface** (Paries anterior) is convex, looking upwards and forwards. It is overlapped by the left lobe of the liver, on which it causes the *gastric impression.*[87] It also rests against the anterior abdominal wall in the subcostal triangle and

against the diaphragm under cover of the left costal arches.

The **œsophageal orifice or cardia** (Id.) is situated [91] below the left lateral ligament of the liver, below and to the left of the œsophageal opening in the diaphragm, slightly to the left of the fissure for the ductus venosus. Beside the cardia a small "**bare area**" of the inferior surface is fixed to the diaphragm by the ***GASTROPHRENIC LIGAMENT***.[36, 97]

The **lesser curvature** (Curvatura ventriculi minor) curls round the *omental tuberosity* and is attached by the lesser gastric mooring [94] to the liver and diaphragm along the lesser gastric line.

The **pylorus** (Id.) rests in front of the neck of the pancreas [107] beside the *umbilical fissure* [87] of the liver.

93. The **Supramesocolic portion of the duodenum** (Id.) lies [51, 52] within the epigastrium, behind and below the liver [87] and gall-bladder.[88] It begins at the pylorus, and curling round the head of the pancreas [106] it ends at the transverse colic line, where the duodenum [65] descending in front of the right kidney [123] is crossed by the transverse colon.[61]

(Pars superior). — The duodenum first runs from the pylorus towards the right, above and to some extent in front of the neck and head of the pancreas, below and behind the quadrate lobe of the liver as far as the neck of the gall-bladder, at first lying in front of the inferior vena cava, and then passing backwards over the right side of the vein into a posterior plane.

(Pars descendens).—It now rests against the duodenal impression on the liver to the right of the gall-bladder, and, lying in a groove on

the right side of the head of the pancreas, descends in front of the outer aspect of the inferior vena cava and the right suprarenal capsule[121] and kidney to terminate behind the transverse colon at the transverse colic line.

Note.—Here the duodenum is separated from the inferior vena cava by the gastroduodenal artery, portal vein, and common bile-duct.[88]

PERITONEUM of the supramesocolic portion of the duodenum. From the pylorus to its first encounter with the common bile-duct the duodenum is attached to the gastric moorings and **floats**. Beyond the common bile-duct as far as the transverse colic line it is **fixed** behind and on its concave side, but is elsewhere covered by peritoneum.

Note. — The above description of the stomach and duodenum holds only so long as the stomach is empty.[87]

Note. — (i) The duodenum has been described above in two portions, a **supramesocolic** portion[93] belonging to the cœliac, and an **inframesocolic** portion[65] belonging to the mesenteric compartment, the limit between the two portions corresponding approximately to the biliary papilla. (ii) In relation to the peritoneum[93, 65] the duodenum is divisible into two parts, which may be called the **floating** duodenum and the **fixed** duodenum. (iii) According to its direction the duodenum is divisible into **three "parts,"** a superior or first part[93] (Pars superior) as far as the neck of the gall-bladder, a descending or second part[93, 65] (Pars descendens), and an inferior or third part[65] (Pars inferior), the last "part" being subdivisible into a transverse portion (Pars horizontalis) and an ascending portion (Pars ascendens). The

first and more than half of the second part belongs to the cœliac, the remainder of the second and the whole of the third part to the mesenteric compartment.

Arteries of the (supramesocolic portion of the) duodenum.[54]

VISCERAL RELATIONS OF THE SUPRAMESOCOLIC PORTION OF THE DUODENUM.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.		Liver and gall-bladder. Stomach. Pancreas.	
P.		Capsule. Kidney.	
U.M.		Colon, transverse. Duodenum.*	

* Inframesocolic portion.

94. **Lesser curvature of the stomach, *LESSER GASTRIC MOORING* and lesser gastric line.** The stomach is fixed[92] beside the cardia, and the duodenum is fixed[93] where it first encounters the common bile-duct. Between these limits the stomach and floating duodenum form a loop which is moored on the side of the lesser curvature by the lesser, and on the side of the greater curvature by the greater gastric mooring.

The **lesser gastric mooring**, *i.e.* **the hepato-gastroduodenal ligament or hepatic omentum** [36, 89] (Omentum minus), moors the lesser curvature of the stomach and the floating duodenum along the lesser gastric line [89] from the transverse fissure to the cardia. Between the transverse fissure and the duodenum the mooring has a free margin which contains the common bile-duct [88] and over which the peritoneum is continuous. On the side of the lesser curvature, therefore, the inferior surface of the stomach can be approached only through the ring or hole behind the free margin of the lesser mooring, namely—

95. **The foramen of Winslow** (Foramen epiploicum). This is formed as follows:

Behind, the *inferior vena cava* [136] is fixed to the wall of the abdominal cavity.

Above, the *caudate lobe* [78] of the liver is fixed to the front of the inferior vena cava, which it separates from the transverse fissure.

In front, the *free margin of the hepatic omentum*, [89] containing the common bile-duct, descends from the transverse fissure to the first part of the duodenum.

Below, the *first part of the duodenum* [93] passes backwards to where the second part is fixed in front and to the right of the inferior vena cava.

Note.—A finger introduced from the right into the foramen of Winslow slips first above the duodenum, then above the common bile-duct, hepatic artery, and portal vein.

96. *Note.*—The **fundus** of the stomach (Fundus v.) bulges upwards into the left cupola of the diaphragm, [149] from which it is separated in the

neighbourhood of the cardia by the left lobe of the liver.

97. Greater curvature of the stomach, ***GREATER GASTRIC MOORING***, and greater gastric line.—The greater curvature of the stomach (Curvatura ventriculi major) passes over the fundus in contact with the liver [87] and left cupola of the diaphragm.[149] It then descends in contact with the lateral slope of the diaphragm and inner surface of the spleen.[102] Finally, it passes to the right in contact with the transverse colon.[61] Just to the left of the cardia the "bare area" of the stomach is fixed to the diaphragm by the *gastrophrenic ligament*.[92] Beyond this the stomach is moored to the spleen by the **splenic omentum** [104] (Lig. gastrolienale) and to the transverse colon by the **colic omentum** [47] (Lig. gastrocolicum). But the spleen is moored to the left suprarenal capsule and kidney by the **lienorenal ligament** [104] (Lig. phrenicolienale), and the transverse colon is moored to the pancreas by the **transverse mesocolon** [61] (Mesocolon transversum). The greater curvature of the stomach and the floating duodenum are thus indirectly moored to the left suprarenal capsule and kidney by the **gastrorenal ligament** [104] and to the pancreas by the **gastropancreatic ligament.**[61] The gastrorenal and gastropancreatic ligaments together constitute the **greater gastric mooring.** This is the homologue of the mesenteries [35] and has its "origin" along the *greater gastric line* which runs from the bare area [92] downwards and to the left over the left suprarenal capsule [121] and kidney,[122] and then turning to the right coincides with the transverse colic line [61] as far as the gastroduodenal artery,[116] beside which it may ascend to reach the duodenum. The inferior surface of the stomach

therefore cannot be approached on the side of the greater curvature. But on the side of the lesser curvature access is only possible behind the right free margin of the lesser mooring, *i.e.* through the foramen of Winslow.[94, 95] The **gastric sheet**, consisting of the stomach and floating duodenum together with the lesser and greater gastric moorings, by being tacked down in this manner shuts off a considerable **recess of the abdominal cavity** which does not communicate with the rest of the cavity except through the foramen of Winslow.

98. ***SMALL SAC OF PERITONEUM*** (Bursa omentalis).—The peritoneal sac presents a corresponding complication. By reason of its invagination by the gastric sheet it is divided into a "**great sac**" which lines the greater portion of the abdominal cavity and a "**small sac**" which lines the recess shut off by the gastric sheet, the two "sacs" being continuous through the foramen of Winslow. The small sac belongs to the cœliac compartment, but descends within the fold of the colic omentum[47] below the level of the transverse colon.

Note.—The small sac is not a diverticulum of the great sac. The small and great sacs are merely complementary portions of the peritoneal sac lining complementary portions of the abdominal cavity.

Note.—The coronary and hepatic arteries in passing forwards raise the pancreaticogastric folds[114, 116] and thus constrict the small sac dividing it into an upper and a lower portion.

Note.—The greater mooring is not attached along the whole length of the greater curvature, for in its upper part the line of attachment passes behind the fundus to reach the cardia.

99. *Note.*—

(i). The **gastric sheet**[97] consists of

hepatic omentum,
stomach and floating duodenum,

colic omentum,	splenic omentum,
transverse colon,	spleen,
transverse mesocolon,	lienorenal ligament.

(ii). The **inferior surface of the stomach** which looks downwards and backwards rests on

	splenic omentum,
transverse colon,	spleen,
transverse mesocolon,	lienorenal ligament,
pancreas,	left capsule and kidney,

abdominal wall.

Vessels and nerves of the stomach.
See arteries[54] and pneumogastric nerves.[118]

VISCERAL RELATIONS OF THE STOMACH.

	External to the Right Poupart Line.	Between the Poupart Lines.	External to the Left Poupart Line.
U.C.		Liver.	Liver.
		Duodenum.	
		Spleen.	Spleen.
		Pancreas.	Pancreas.
P.		Capsule.	
		Kidney.	
U.M.		Colon, transverse.	Colon, transverse.

100. **Spleen.**

The **Spleen** (Lien) is situated in the gastro-renal ligament,[104] the external peritoneal layer of which it bulges out so as to be almost entirely in relation to the great sac. Internally, it is wedged in between the stomach[99] in front, the left suprarenal capsule (?) and kidney[123] behind, and the colon[61, 62] below. Externally, it rests against the posterior and lateral slopes of the diaphragm. From its narrow upper end (Extremitas superior), which lies[51, 52] within the epigastrium, it extends downwards, outwards, and slightly forwards through the left hypochondrium, following the course of the 9th, 10th, and 11th ribs until its broad lower end (Extremitas inferior) rests above and external to the splenic flexure of the colon and the colicophrenic ligament (Sustentaculum lienis).[57] Above the colon it is touched by the tail of the pancreas.[105] The spleen has thus two surfaces, parietal and visceral, and a dividing margin or border (cf. liver[74]).

101. The **external, parietal, or phrenic surface** (Facies diaphragmatica) is triangular and convex, resting against the diaphragm.

102. The **internal or visceral surface** is also triangular and is moulded by the stomach,[99] kidney,[123] and splenic flexure of the colon[61, 62] into **three main impressions,** the gastric (Facies gastrica) above and in front, the renal (Facies renalis) above and behind, the colic below. The impressions are separated from each other by **three ridges**, gastrorenal, colicorenal, and gastrocolic, of which the gastrorenal is the best marked, so that it is sometimes called the internal border of the spleen. On the gastric impression (*a*) close beside the point of convergence of the

three ridges is the **pancreatic impression** for the tail of the pancreas,[105] and (*b*) parallel to the gastrorenal ridge is the **hilus** (Hilus lienis), a slit through which vessels and nerves[115] enter and leave the spleen.

103. The **dividing margin** or border of the spleen consists of **three parts**, gastric, renal, and colic, separated by **three angles**, gastrorenal, colicorenal, and gastrocolic. In accordance with its position it may be described as consisting of three parts, anterior (Margo exterior), posterior (Margo posterior), and inferior, separated by three angles, posterior or vertebral, inferior, and anterior.

Note.—When the spleen is at too high a level to be in relation with the splenic flexure its form is modified, chiefly by the narrowing of the lower end. The colic impression vanishes, the two ridges which should have bounded it coinciding to form a single ridge which appears as a continuation of the gastrorenal ridge. The visceral surface is thus moulded into two impressions, gastric and renal, the former of which presents a small impression for the tail of the pancreas.

104. ***PERITONEUM*** of the spleen. The spleen lies between the two peritoneal layers of the **gastrorenal ligament**,[36, 97] which it thus divides into the **gastrosplenic ligament or splenic omentum** (Lig. gastrolienale) and the **lienorenal ligament** (Lig. phrenicolienale).

From the superior surface of the stomach the peritoneum of the great sac sweeping round the greater curvature passes over the splenic omentum to the hilus of the spleen, thence over the spleen by way of the gastric impression, phrenic surface, and renal impression to the gastrorenal ridge, and, finally,

over the lienorenal ligament to the greater gastric line where it turns outwards over the left suprarenal capsule [121] and kidney.[122]

From the inferior surface of the stomach the peritoneum of the small sac passes over the splenic omentum to the hilus of the spleen, thence over the spleen by way of the gastric impression to the gastrorenal ridge, and, finally, over the lienorenal ligament to the greater gastric line where it turns inwards over the left suprarenal capsule and kidney.

Vessels and nerves of the spleen.

See arteries [54] and right pneumogastric nerve.[118]

VISCERAL RELATIONS OF THE SPLEEN.

	External to the Right Poupart Line.	Between the Poupart Lines.		External to the Left Poupart Line.
U.C.		Stomach.		Liver (?) Stomach. Pancreas.
P.			Capsule. Kidney.	Kidney.
U.M.				Colon, transverse. descending.

105. Pancreas.

The **Pancreas** [51, 52] (Id.) lies within the epigastrium and to some extent within the left hypochondrium. It is ***FIXED*** at the level of the **transverse colic line** in front of the great blood-vessels and the left supra-

renal capsule [121] and kidney.[122] The head is encircled by the duodenum,[93, 65] the tail touches the spleen.[100] The **transverse colon** [61] is attached by its **mesocolon** in front of the head and along the anterior border of the body, so that the pancreas [109] is in relation not only with the stomach [99] and duodenum [93] in the cœliac but also with the duodenum [65] and jejuno-ileum [66] in the mesenteric compartment.

Note.—Although the pancreas is divided into a supramesocolic portion which lies [113] within the cœliac compartment and an inframesocolic portion which lies [67] within the mesenteric compartment, it is convenient to regard the whole pancreas as an organ of, *i.e.* belonging to, the cœliac compartment.

106. The **head** (Caput p.) is fixed in front of the inferior vena cava and to a slight extent also in front of the aorta. The duodenum [93, 65] overlaps it above, descends in a groove on its right side (duodenal impression), and is itself overlapped by the pancreas below. The transverse colon [61] is fixed along the transverse colic line, below which the head is overlapped by coils of jejuno-ileum.[66] The *common bile-duct* [88] descending behind the first and then between the pancreas and the second part of the duodenum joins company with the pancreatic duct,[110] and the two ducts piercing obliquely the inner wall of the second part about its middle open by a common orifice on the **biliary papilla.** The orifice is smaller than either duct. The common lumen immediately preceding the orifice is relatively wide and is known as the **ampulla of Vater.**

107. The **neck** ascends from the right upper portion of the head towards the left, being separated from the left portion of the head by a

deep notch (Incisura pancreatis). It lies below and behind the pylorus.[92]

108. The **body** (Corpus p.) is wedged in between the stomach[99] in the cœliac, and the duodenum[65] and jejuno-ileum[66] in the mesenteric compartment. It has consequently three surfaces and three borders.

The **posterior surface** (Facies posterior) is fixed in front of the aorta and the left suprarenal capsule[121] and kidney.[123]

The *anterior border* (Margo anterior) coincides with the transverse colic line, to which the transverse mesocolon moors the transverse colon.[61]

The **superior surface** (Facies anterior) is moulded by the inferior surface of the stomach[99] and looks upwards and forwards.

The *superior border* (Margo superior) has important relations to blood-vessels.

The **inferior surface** (Facies inferior) looks downwards and rests upon the duodenojejunal flexure,[65] the jejuno-ileum,[66] and the colon beside the splenic flexure.[61, 62]

The *inferior border* (Margo posterior).

109. The **tail** (Cauda p.) lies above the splenic flexure of the colon[61, 62] in front of the left kidney,[123] behind the stomach,[99] and internal to the spleen.[102]

110. The **duct of the pancreas**[115] (Ductus pancreaticus Wirsungi) runs from the tail through the body of the gland, descends in the neck and then passes transversely through the head to join company with the *common bile-duct*.[88, 106] There is also a small

accessory pancreatic duct (Ductus pancreaticus accessorius Santorini) which runs in the head upwards and to the right, and communicates both with the main duct and with the duodenum above the biliary papilla.

III. The *PERITONEUM* of the pancreas is divided into two portions by the attachment of the transverse colon and mesocolon along the transverse colic line.

The **inframesocolic portion** lies in the mesenteric compartment and belongs to the great sac.

The **supramesocolic portion** lies in the cœliac compartment, and belongs for the most part to the small sac. To the right of the gastroduodenal artery,[97, 116] however, part of the pancreas may be covered by peritoneum belonging to the great sac.

Arteries of the pancreas.[54]

Relation of the pancreas to blood-vessels.[119]

VISCERAL RELATIONS OF THE PANCREAS.

	External to the Right Poupart Line.	Between the Poupart Lines.		External to the Left Poupart Line.
U.C.		Stomach and duodenum.		Stomach. Spleen.
P.			Capsule. Kidney.	Kidney.
U.M.		Colon, transverse. Duodenum and jejuno-ileum.		Colon, transverse.

112. VESSELS AND NERVES OF THE UNPAIRED ORGANS OF THE CŒLIAC COMPARTMENT.

113. The **CŒLIAC TERRITORY** comprises the unpaired organs of the cœliac compartment, namely—

Liver and gall-bladder.
Lower end of the œsophagus, stomach, and supramesocolic portion of the duodenum.
Spleen.
Pancreas (supramesocolic portion).[67, 105]

The **cœliac artery** (A. cœliaca) is the first unpaired-visceral branch[132] of the abdominal aorta, from the front of which it arises at the upper border of the *pancreas*. It soon divides into three branches, coronary, splenic, and hepatic.

The **hepatic veins**[116] (Vv. hepaticæ) pass directly from the liver to the *inferior vena cava*[136] as it lies in its fissure,[78] returning the blood, not only of the cœliac, but also of the superior and inferior mesenteric territories.

The blood supplied to the liver by the *hepatic branches of the hepatic artery*[116] flows through capillaries in the liver, from which it is drained by the hepatic veins.

The blood supplied to the *remaining unpaired viscera* of the abdomen proper, after passing through capillaries in the respective organs, is collected into the *portal vein*[117] and then flows through capillaries in the liver, from which it is finally drained by the hepatic veins.

The **cœliac lymph stream** drains the cœliac territory into the cœliac *glands*[139] which lie around the trunk of the cœliac artery and in front of the aorta.

The **cœliac sympathetic nerve plexus,** an offshoot of the abdominal aortic plexus,[143] surrounds the trunk of the cœliac artery.

114. The CORONARY TERRITORY comprises—

Œsophagus—lower end.

Stomach—(*a*) cardia and fundus as far as the summit;

(*b*) lesser curvature almost as far as the pylorus.

The **coronary artery** (A. gastrica sinistra) runs from the cœliac artery upwards, raising the falx coronaria or **left pancreaticogastric fold,**[36] to the cardia, where it divides into two branches, the **œsophageal** (Rami œsophagei) ascending to supply the lower end of the œsophagus and the cardia and fundus of the stomach as far as the summit, the **gastric** descending to supply both surfaces of the stomach from the lesser curvature.

The **coronary vein** (V. coronaria ventriculi) corresponds to the coronary artery, but it terminates in the *portal vein.*[117]

The **coronary lymph stream** flows into the cœliac *glands. Glands* are found (1) along the lesser curvature, (2) encircling the cardia, (3) along the trunk of the coronary artery in the falx.

The **coronary sympathetic nerve plexus** (Plexus gastricus superior) is an offshoot of the cœliac plexus along the coronary artery.

115. The SPLENIC TERRITORY comprises—

Stomach—from the summit of the fundus to the middle of the greater curvature.

Spleen.

Pancreas—body and tail.

The **splenic artery** (A. lienalis) runs from the cœliac artery to the left in a groove along the upper border of the *pancreas* in front of the left suprarenal capsule and kidney and then by way of the lienorenal ligament to the hilum of the spleen, where it breaks up into its **splenic** branches (Rami lienales). Besides **pancreatic** branches (Rami pancreatici) it also gives off the **vasa brevia** (Aa. gastricæ breves) and the **left gastro-epiploic** artery (A. gastro-epiploica sinistra) which reach the stomach by way of the splenic omentum, and proceed, the former towards the fundus, the latter along the greater curvature towards the pylorus.

The **splenic vein** (V. lienalis) corresponds to the splenic artery, but, as it passes from left to right behind the body of the *pancreas*, it receives the *inferior mesenteric* vein,[70] and it terminates behind the neck of the pancreas by joining the *superior mesenteric*[70] to form the *portal* vein.[117]

The **splenic lymph stream** flows into the cœliac *glands*. *Glands* are found (1) at the hilus of the spleen, (2) along the trunk of the splenic artery at the upper border of the pancreas.

The **splenic sympathetic nerve plexus** (Plexus lienalis) is an offshoot of the cœliac plexus along the splenic artery.

116. The HEPATIC TERRITORY comprises—

Liver and gall-bladder.
Stomach towards the pylorus and duodenum—supramesocolic portion.
Pancreas—part of the head.

The **hepatic artery** (A. hepatica) runs from the cœliac artery to the right along the upper border of the *pancreas*, turns forwards, raising the falx hepatica

or **right pancreaticogastric fold,**[36] to the upper border of the duodenum, and ascends [88] in the hepatic omentum to the transverse fissure of the liver where it divides into its two **hepatic** branches (Rami dexter et sinister), of which the right branch gives the **cystic** artery (A. cystica) to the gall-bladder. The hepatic artery also gives off the **pyloric** artery (A. gastrica dextra) to supply the lesser curvature for a short distance and the **gastroduodenal** artery (A. gastroduodenalis), which descends behind the duodenum in front of the head of the pancreas and divides into the *right gastro-epiploic* (A. gastro-epiploica dextra) for the greater curvature and the *superior pancreaticoduodenal* (A. pancreaticoduodenalis superior) for the pancreas and duodenum.

The **hepatic veins** [113] (Vv. hepaticæ) do not accompany the hepatic artery in any part of its course but pass directly from the liver to the *inferior vena cava* as it lies in its fissure. They return the blood, not only from the hepatic territory, but from the whole of the cœliac as well as the superior and inferior mesenteric territories.

The **hepatic lymph stream** flows into the cœliac *glands. Glands* are found (1) beside the hepatic branches at the transverse fissure, beside the common bile-duct and along the trunk of the hepatic artery in the hepatic omentum, in the right pancreaticogastric fold, and along the upper border of the pancreas; (2) beside the pyloric artery in the hepatic omentum; (3) beside the right gastro-epiploic artery in the colic omentum; (4) beside the bifurcation of the gastroduodenal artery in front of the head of the pancreas.

The **hepatic sympathetic nerve plexus**

(Plexus hepaticus) is an offshoot of the cœliac plexus along the hepatic artery.

117. *Note.*—The **portal vein** (V. portæ) drains into the liver all the unpaired-visceral blood of the abdomen proper except that which is supplied to the liver by the hepatic branches of the hepatic artery.[116]

The *inferior mesenteric territory*[67] is drained by the **inferior mesenteric** vein[70] into the splenic vein.[115]

The *superior mesenteric territory* is drained by the **superior mesenteric** vein which joins the splenic to form the portal vein.

The *cœliac territory*[113] (except the liver) is drained by the (1) **coronary,**[114] (2) **splenic,**[115] (3) **pyloric, superior pancreaticoduodenal and cystic**[116] veins into the portal vein, and by the **right gastro-epiploic**[70] into the superior mesenteric vein.

(*a*) The portal vein begins behind the neck of the *pancreas* in front of either the upturned portion of the head of the pancreas or the left border of the inferior vena cava. (*b*) It ascends behind the neck of the pancreas and first part of the duodenum in front of the inferior vena cava. (*c*) Passing forwards in the right pancreaticogastric fold[116] it ascends[88] behind the common bile-duct and hepatic artery in the free margin of the hepatic omentum, which is separated by the foramen of Winslow[95] from the inferior vena cava. (*d*) It terminates at the right end of the transverse fissure of the liver where it is separated[95] by the caudate lobe from the inferior vena cava. The portal vein (i) is formed by the junction of the **superior mesenteric** and **splenic** veins, (ii) receives in its course the **coronary, pyloric, and superior pancreatico-duodenal** veins, and (iii) terminates by dividing into

right and left branches. The right branch, which is short and wide, receives the *cystic* vein, and enters the right lobe of the liver. The left branch is longer and narrower. It passes to the left along the transverse fissure, giving branches to the quadrate and Spigelian lobes, then crossing the longitudinal fissure it enters the left lobe. Beside the longitudinal fissure[78] it gives attachment to two fibrous cords—in front, to the *obliterated umbilical vein*[40]; behind, to the *obliterated ductus venosus.* In the fœtus both these structures are patent, so that blood returning from the placenta by the umbilical vein passes partly through the portal vein into the liver, partly through the ductus venosus into the inferior vena cava.

118. *Note.*—The **pneumogastric nerves** (N. vagus) descend from the œsophageal plexus in the thorax through the œsophageal opening[150] in the diaphragm into the abdomen.

The **left** pneumogastric nerve, entering the abdomen *in front* of the œsophagus, distributes itself along the lesser curvature and over the *superior surface* of the stomach, and communicates with the *hepatic* sympathetic plexus.[116]

The **right** pneumogastric nerve, entering the abdomen *behind* the œsophagus, distributes itself over the *inferior surface* of the stomach, and communicates with the *cœliac*, *splenic*, and *renal* sympathetic plexuses.[113, 115, 129]

119. *Note.*—**BLOOD-VESSELS** IN RELATION WITH THE PANCREAS.

ARTERIES.	VEINS.
Aorta.	Inferior vena cava.
i. Cœliac.	Portal vein.
Splenic.	Splenic.
Pancreatic.	Pancreatic.
	Inferior mesenteric.
Hepatic.	
Gastroduodenal.	Sup. pancreaticoduodenal.
R. gastro-epiploic (?)	Superior mesenteric.
Sup. pancreaticoduodenal.	R. gastro-epiploic.
Superior mesenteric.	Inf. pancreaticoduodenal.
Inf. pancreaticoduodenal.	
ii. Suprarenal.	L. suprarenal.
Renal.	L. renal.

Note.—Distribution of the arterial supply to the unpaired viscera of the cœliac compartment.[54]

III.

Paired Organs.

120. The paired organs consist of—
Suprarenal capsules.
Kidneys.
Testes.

121. Suprarenal capsules.

The **Suprarenal capsules** (Glandula suprarenalis) lie [51, 52] wholly within the epigastric region surmounting the upper end of the kidneys.[122] They are somewhat triangular and are flattened so as to have two surfaces, anterior and posterior.

Right Capsule.	Left Capsule.
The **anterior surface** is to a large extent bared of ***PERITONEUM*** by (*a*) the liver [87], (*b*) the inferior vena cava, and sometimes (*c*) the second part of the duodenum.[93] The hilus is situated in its upper part.	The **anterior surface** rests against the stomach [99] and is covered by ***PERITONEUM***, except where it is crossed by (*a*) the lienorenal ligament [104] and (*b*) the pancreas [105] and splenic vessels.[115] The hilus is situated in its lower part.
The **posterior surface** is ***FIXED*** partly to the diaphragm, partly in front of the upper end of the kidney (renal impression).	

Vessels and nerves of the suprarenal capsules.[129]

VISCERAL RELATIONS OF THE SUPRARENAL CAPSULES.

	External to the Right Poupart Line.	Between the Poupart Lines.		External to the Left Poupart Line.
U.C.		Liver. Duodenum.	Stomach. Spleen (?) Pancreas.	
P.		Kidney.	Kidney.	

122. Kidneys.

The **Kidneys** (Ren) lie [51, 52] for the most part within the epigastric region, but they usually descend slightly below the subcostal plane and about one-third of each lies external to the Poupart plane. Each kidney may thus lie within four regions.

The kidneys are fixed to the diaphragm and posterior abdominal wall, the left at a higher level than the right. Each is crossed by the transverse colon,[123] so as to fall partly within the cœliac, partly within the mesenteric compartment. Each has an **anterior surface** (Facies anterior), a **posterior surface** (Facies posterior), and a **dividing margin** or border. Owing to the forward projection of the vertebral column with the muscles which lie along it, the inner border (Margo medialis) of each kidney is tilted forwards so that the outer border (Margo lateralis) looks almost directly backwards, while the surfaces look not only forwards and backwards but also outwards and inwards respectively. In addition the

long axis of each kidney is oblique, the upper end or pole (Extremitas superior) being nearer the middle line than the lower (Extremitas inferior). The **hilus** (Hilus renalis) being on the inner border looks also somewhat forward. If then the kidney be regarded as having a visceral and a parietal surface, the **visceral surface** will include the anterior surface and inner border, the **parietal surface** will include the posterior surface and outer border.

PERITONEUM of the kidneys.

Right Kidney.	Left Kidney.
The **visceral surface**[123] is bared of peritoneum by (*a*) the suprarenal capsule; (*b*) the duodenum; (*c*) the colon.	The **visceral surface** is bared of peritoneum by (*a*) the suprarenal capsule; (*b*) the lienorenal ligament[104]; (*c*) the pancreas[105] and splenic vessels.[115]
The **parietal surface**[124] is ***FIXED*** to the diaphragm and posterior abdominal wall.	

123. Vessels and nerves of the kidneys.[129]

VISCERAL RELATIONS OF THE KIDNEYS.

	External to the Right Poupart Line.	Between the Poupart Lines.		External to the Left Poupart Line.
U.C.	Liver.	Duodenum.	Stomach.	Spleen.
			Pancreas.	Pancreas.
P.		Capsule.	Capsule.	
U.M.	Colon, transverse. ascending.	Colon, (transverse).		Colon, (transverse). descending.
	Jejuno-ileum.	Duodenum.	Jejuno-ileum.	Jejuno-ileum.

Note.—The visceral relations of the kidneys may be studied *constructively* as follows :—

RIGHT KIDNEY.	LEFT KIDNEY.
P. The right **suprarenal capsule** [121] surmounts the upper end of the kidney and is fixed partly to the diaphragm, partly in front of the kidney.	The left **suprarenal capsule** surmounts the upper end of the kidney and is fixed partly to the diaphragm, partly in front of the kidney.
U.M. The **colon** is fixed in front of the kidney as follows :	The **colon** is fixed in front of the kidney as follows :
The *ascending* colon [60] ascends and is fixed in front of the outer part of the kidney.	

RIGHT KIDNEY.	LEFT KIDNEY.
(The *transverse* colon[61] crosses inwards and is fixed in front of the kidney, rather below the hilus.)*	(The *transverse* colon crosses outwards in front of the kidney, rather above the hilus.)* The *descending* colon[62] descends and is fixed along the outer part of the kidney.
The **duodenum,** descending in front of the inner border of the kidney, is crossed by the transverse colon, so that both its supramesocolic[93] and inframesocolic portions are in relation with the kidney. The **inframesocolic**[65] portion emerging from behind the transverse colon descends and is fixed in front of the inner border of the kidney internal to the ascending colon.	
The **jejuno-ileum**[66] may overlap the kidney within the bend of the colon, *i.e.* the hepatic flexure, external to the second part of the duodenum.	The **jejuno-ileum** overlaps the kidney within the bend of the colon, *i.e.* the splenic flexure.
U.C. The **liver**[87] rests in front of the outer part of the kidney, above the hepatic flexure of the colon.	
The **duodenum** in its **supramesocolic**[93] portion descends and is fixed in front of the inner border of the kidney above the transverse colon and internal to the liver.	The **stomach**[99] rests in front of the inner part of the kidney above the transverse colon.

* The transverse colon is separated from the inner border of the right kidney by the duodenum,[65, 93] and from the left kidney by the pancreas.[105]

RIGHT KIDNEY.	LEFT KIDNEY.
	The **spleen** [100] rests in front of the outer part of the kidney above the splenic flexure of the colon, behind and external to the stomach.
	The **pancreas** [105] is fixed across the kidney behind the transverse colon, below and behind the stomach, and internal to the spleen.

124. **Parietal relations** of the kidneys. Each kidney, encased in a strong fibrous capsule, lies embedded in a mass of extraperitoneal connective tissue [46] in front of the bounding fascia,[148, 154] behind which it is in relation with the diaphragm [149] and the muscles of the posterior abdominal wall, [155] namely, transversalis, quadratus lumborum, and psoas, and also with the 12th rib and the transverse processes of the 1st, 2nd, and 3rd lumbar vertebræ.

125. **Ureters.**—Each ureter (Id., pars abdominalis) begins at the hilus [122] of the kidney in a dilatation known as the ureteric pelvis (Pars pelvina). Descending behind the spermatic artery, in front of the transverse processes of the 2nd to 4th lumbar vertebræ, from which it is, however, separated by the bounding fascia [154] and psoas muscle,[157] it crosses in front of the bifurcation of the common iliac artery [131] to enter the true pelvis. Like the kidney it is fixed to the abdominal wall. The right ureter is crossed in front by the second part of the duodenum [65] and the enteric line,[66] and lies close to the right side of the inferior vena cava.[138]

126. Testes.*

The testes, originally situated in front of the lower end of the kidneys, descend in the course of development into the two evaginations [6] of the musculo-aponeurotic wall which occupy the scrotum. Each of these evaginations contains a **diverticulum of the abdominal cavity**, within which lie—

I. Extraperitoneal connective tissue.
II. Testis and vas deferens (duct of the testis).
III. Peritoneum.
Vessels and nerves.

I.–II. **Testes.**—The testis (Id.) is a fixed organ, since its posterior surface is directly attached by extraperitoneal connective tissue to the bounding fascia, which is here represented by the infundibuliform fascia.[25] The vas deferens,[127] vessels, and nerves [129] are loosely held together by the extraperitoneal connective tissue so as to form the **spermatic cord** (Funiculus spermaticus).[6]

127. **Vasa deferentia.**—The vas deferens (Ductus deferens) on each side ascends from the epididymis of the testis behind the vessels and nerves in the spermatic cord [126] to the internal abdominal ring,[25] where it parts from the other constituents of the cord on the outer side of the external iliac vessels.[131] The vas deferens now turns inwards above and behind the deep epigastric artery,[43] and, crossing over the external iliac vessels and the interval between these vessels and the pelvic brim, enters the true pelvis.

128. III. The ***PERITONEUM*** at birth consists

* For the Female, see Appendix.

of the **processus vaginalis** (P. v. peritonæi), a diverticulum of the peritoneal sac with which it is in direct communication. The spermatic cord and testis lie in the extraperitoneal connective tissue between the infundibuliform fascia [25] and the processus vaginalis. The portion of the processus vaginalis which is in relation with the spermatic cord or funiculus spermaticus is called the **funicular process**; about the time of birth its lumen becomes obliterated, and it shrivels up into a small fibrous band, the **ligamentum vaginale,** which persists in the adult as a slender fibrous filament. The portion of the processus vaginalis which is in relation with the testis is called the **tunica vaginalis.** [35, 36] By the degeneration of the funicular process it becomes cut off from the peritoneal sac, persisting thereafter as an independent serous sac. The tunica vaginalis descends to a lower level than the testis; it also reaches a higher level so as to be in relation with the lower part of the spermatic cord. It consists of a parietal and a visceral portion.

Note.—The testes themselves, like the ovaries, are covered not by peritoneum but by germ-epithelium.

Vessels and nerves of the testes.[129]

129. **VESSELS AND NERVES** OF THE PAIRED ORGANS.

Arteries.	Veins.	Lymph Streams.	Nerves (sympathetic plexuses).
			Suprarenal.
			Renal.
			Spermatic.

ARTERIES.

The arterial supply is derived from the paired-visceral branches [132] of the abdominal aorta, with an additional supply from the inferior phrenic arteries.

The **suprarenal** arteries (A. suprarenalis media) arise from the sides of the aorta [132] behind the *pancreas* opposite the origin of the superior mesenteric artery. Each artery runs outwards and upwards on the crus of the diaphragm, the right artery passing behind the inferior vena cava. Each capsule is also supplied by the **suprarenal branch of the inferior phrenic** [152] (Rami suprarenales superiores) and the **suprarenal branch of the renal** artery (A. suprarenalis inferior).

The **renal** arteries (A. renalis) arise from the sides of the aorta [132] behind the *pancreas*, immediately below the origin of the superior mesenteric artery. Each artery passes transversely outwards on the crus of the diaphragm and the psoas muscle, and at the hilus of the kidney breaks up into its renal branches, all which are usually in front of the ureter though one or more may be behind it. The right renal artery passes behind the inferior vena cava and the second part of the duodenum, the left behind the body of the pancreas. Branches—

Suprarenal.
Renal.
Ureteral.

The **spermatic** * arteries (A. spermatica interna) arise from the front of the aorta [132] below the pancreas but above the origin of the inferior mesenteric artery. Each artery passes outwards and downwards on the psoas muscle and in front of the ureter towards the

* For the Female, see Appendix.

internal abdominal ring to join the other constituents of the spermatic cord. The right artery passes in front of the inferior vena cava, behind the third part of the duodenum, the termination of the ileum, and the appendix; the left passes behind the iliac colon. In the cord the spermatic artery is tortuous. Branches—

Ureteral.
Terminal.
Epididymal.
Testicular.

The **artery to the vas** (A. deferentialis) is derived from the inferior or sometimes the superior vesical artery in the pelvis and accompanies the vas deferens as far as the testis.

VEINS.

The **suprarenal** veins (V. suprarenalis) return the blood from the suprarenal capsules to the inferior vena cava,[136] the right vein directly, the *left* by way of the left renal vein.

The **renal** veins (V. renalis) return the blood from the kidneys to the inferior vena cava.[136] The *left* vein also receives the left suprarenal and left spermatic vein. Each renal vein usually lies below and in front of the artery.

The **spermatic** veins (V. spermatica) return the blood from the testes to the inferior vena cava,[136] the right vein directly, the *left* by way of the left renal vein. In the spermatic cord the veins are numerous and form the **pampiniform plexus** which lies for the most part in front of the other constituents of the cord. Near the internal abdominal ring the plexus

terminates in two veins, which accompany the artery for some distance before joining to form a single trunk.

LYMPH STREAMS.

The **suprarenal, renal, and spermatic** lymph streams flow into *glands* [139] on the sides of the aorta.

NERVES (offshoots of the aortic sympathetic plexus [143]).

The **suprarenal, renal, and spermatic plexuses** (Plexus suprarenalis, renalis, et spermaticus) accompany the corresponding arteries. Each suprarenal plexus receives twigs from the inferior phrenic and renal plexuses (cf. Arteries) and each renal plexus gives twigs to the suprarenal and spermatic plexuses (cf. Veins).

130. GREAT VESSELS AND NERVES.

Arteries.	Veins.	Lymphatics.	Nerves (sympathetic).
		Thoracic duct and receptaculum chyli.	Lumbar gangliated cords.
Aorta.	Inferior vena cava.	Aortic lymph stream.	Aortic plexus.
Common iliac.	Common iliac.	Common iliac.	Hypogastric plexus.
External iliac.	External iliac.	External iliac.	
Internal iliac.	Internal iliac.	Internal iliac.	

131. ARTERIES.

The **abdominal aorta** (Aorta abdominalis) is the direct continuation of the thoracic aorta. It begins at the aortic opening [150] in the diaphragm

opposite the lower border of the 12th thoracic vertebra, descends between the crura of the diaphragm in front of the anterior common ligament and vertebral column, and ends opposite the middle of the 4th lumbar vertebra by dividing into its pelvicrural branches, the common iliac arteries.

The **common iliac** arteries (A. iliaca communis) begin at the bifurcation of the aorta, and, descending towards the mid-points between the symphysis pubis and the anterior superior iliac spines, end at the level of the lumbosacral articulation by dividing into the external and internal iliac arteries.

The **external iliac** arteries (A. iliaca externa) begin at the points of bifurcation of the common iliac arteries and, descending to the mid-points between the symphysis pubis and the anterior superior iliac spines, end behind the ligaments of Poupart where they are continuous with the femoral arteries.[7] To the anterior and lateral abdominal walls they give off the

Deep epigastric arteries[43] (A. epigastrica inferior), and the

Deep circumflex iliac arteries[43] (A. circumflexa iliaca profunda).

The **internal iliac** arteries (A. hypogastrica) descend into the pelvis but give some supply to the abdomen proper, namely—

The **iliolumbar** arteries (A. iliolumbalis) reascend into the iliac fossæ behind the points of bifurcation of the common iliac arteries and behind the psoas and iliacus muscles.

(*Nutrient* branches for the iliac bones reascend into the iliac fossæ from the *obturator* arteries in the pelvis.)

132. **BRANCHES** OF THE ABDOMINAL AORTA.

	VISCERAL.		PARIETAL.		PELVI-CRURAL.
	Unpaired-visceral.	Paired-visceral.	Paired.	Unpaired.	Paired.
			Inferior phrenic.[152]		
	Cœliac.[113]		L		
Pancreas.	Superior mesenteric.[68]	Supra-renal.[129]	u		
		Renal.	m (4)		
Duodenum (3rd part).		Spermatic.	b		
	Inferior mesenteric.[69]		a		
			r.[160]	Middle sacral.[160*]	Common iliac.[131]
					External iliac.
					Internal iliac.*

* The middle sacral artery gives off the fifth pair of lumbar arteries. The internal iliac artery on each side gives off the iliolumbar artery.

133. **Relations** of the abdominal aorta.

1. **Peritoneum**, above the pancreas and below the duodenum except at the enteric line.
2. **Unpaired viscera.**
   - Pancreas.[105–108]
   - Duodenum.[65]
3. **Unpaired-visceral vessels.**
   - Cœliac artery, and splenic vein.[113, 115]
   - Superior mesenteric artery.[68]
   - Inferior mesenteric artery.[69]

4. **Paired-visceral vessels.**[129]
   - Suprarenal arteries.
   - Renal arteries, and left renal vein.
   - Spermatic arteries.
5. **Great vessels and nerves.**
   - Inferior vena cava.[136]
   - Aortic lymphatic vessels and glands with the receptaculum chyli and thoracic duct.[139-141]
   - Aortic sympathetic plexus with the semilunar ganglia.[143]
6. **Parietal vessels and nerves.**
   - Inferior phrenic arteries.[152]
   - Lumbar arteries, with the left lumbar veins and vena azygos major.[160, 161]
   - Middle sacral artery.[160]
7. **Parietes.**
   - Crura of the diaphragm.[150]
   - Anterior common ligament.
   - Upper four lumbar vertebræ with the intervening discs.

134. **Relations** of the common iliac arteries.

	RIGHT.	LEFT.
1.	Peritoneum.	
2.		Superior hæmorrhoidal vessels.[69, 70]
3.	Ureter.[125]	
4.	Inferior vena cava.[136]	
	Common iliac vein.[136]	
	Left common iliac vein.	
	Common iliac lymphatics.[139]	

Sympathetic cord.[145]
Communicating branches between the aortic and hypogastric plexuses.[143]

5. Iliolumbar vessels.[131]
Obturator nerve.[164]
Lumbosacral cord.

6. Psoas fascia and muscle.[154, 157]
Anterior common ligament.
Lumbar vertebræ, 4-5, with the intervening disc.

135. **Relations** of the external iliac arteries.

RIGHT.	LEFT.
1. Peritoneum.	
2. Ureter (?)[125]	
Vas deferens.[127]	
3. External iliac vein with the deep circumflex iliac vein.[136]	
External iliac lymphatics.[139]	
4. Genitocrural nerve with its genital branch.[164]	
Obturator nerve.	
5. Fascia iliaca with the psoas muscle.[154, 157]	

136. VEINS.

The **internal iliac** veins (V. hypogastrica) ascend out of the pelvis.

The **external iliac** veins (V. iliaca externa) begin on the inner side of their arteries, but they become more and more posterior until at the level of the lumbosacral articulation they end behind the internal iliac arteries by joining the internal iliac to form the common iliac veins. From the anterior and lateral abdominal walls they receive the

Deep epigastric veins[43] (V. epigastrica inferior), and the

Deep circumflex iliac veins[43] (V. circumflexa ilium profunda).

The **common iliac** veins (V. iliaca communis) ascend to the right side of the 5th lumbar vertebra where they unite behind and to the outer side of the right common iliac artery to form the inferior vena cava. They receive

The **iliolumbar** veins (V. iliolumbalis). The left common iliac vein also receives

The **middle sacral** vein (V. sacralis media).

The **inferior vena cava** (V. cava inferior) begins on the right side of the body of the 5th lumbar vertebra behind and to the outer side of the right common iliac artery, ascends in front and to the right of the vertebral column and right crus of the diaphragm, and leaves the abdomen through the foramen quadratum.[150] In contact with the aorta below, it is separated from it above by the right crus.

137. TRIBUTARIES OF THE INFERIOR VENA CAVA.

VISCERAL.		PARIETAL.		PELVI-CRURAL.
Unpaired-visceral.	Paired-visceral.	Paired.	Unpaired.	Paired.
Hepatic.[113,116]	R. suprarenal.[129]	Inf. phrenic.[152]		
	L. suprarenal. }			
	Renal.	L		
	L. spermatic. }			
		u		
	R. spermatic.			
		m		
		b		Com. iliac.[136]
		a		Ext. iliac.
		r.[161]		Int. iliac.

138. Relations of the inferior vena cava.

1. **Peritoneum.**
   - At the foramen of Winslow[95] between the liver and duodenum.
   - Below the duodenum except at the enteric line.
2. **Unpaired viscera.**
   - Liver.[78]
   - Duodenum.[93, 65]
   - Pancreas.[106]
3. **Unpaired-visceral vessels.**
   - Portal vein.[117]
4. **Paired viscera.**
   - Right suprarenal capsule.[121]
   - Right ureter.[125]
5. **Paired-visceral vessels.**[129]
   - Right suprarenal artery.
   - Right renal artery.
   - Right spermatic artery.
6. **Great vessels and nerves.**
   - Aorta with the right common iliac artery.[133, 136]
   - Aortic lymphatics.[139]
   - Right sympathetic cord, and right semilunar ganglion.[143, 145]
7. **Parietal vessels.**
   - Right inferior phrenic artery.[152]
   - Right lumbar arteries.[160]
8. **Parietes.**
   - Right crus of the diaphragm.
   - Right psoas fascia and muscle.
   - Anterior common ligament.
   - Lower lumbar vertebræ.

139. LYMPH STREAMS.

The **internal iliac** lymph streams ascend out of the pelvis in company with the internal iliac arteries, along which lie the internal iliac *glands*.

The **external iliac** lymph streams accompany the external iliac arteries, along which lie the external iliac *glands*. Besides draining lymph from the pelvis, perineum and thigh, they receive on each side the

Deep epigastric,[43]
Deep circumflex iliac,[43]
Superficial inguinal[8]

lymph streams, the last by way of the superficial inguinal and to some extent the deep femoral *glands*.

The **common iliac** lymph streams, formed by the junction of the internal and external iliac streams, accompany the common iliac arteries, along which lie the common iliac *glands*. Those glands which lie between the two arteries are sometimes called the glands of the promontory. The common iliac lymph streams drain some lymph directly from the pelvis.

The **aortic** lymph stream begins as an upward continuation of the common iliac lymph streams. Ascending in company with the great blood-vessels it is reinforced on the way by tributary streams corresponding to branches of the abdominal aorta. Finally, by **four main trunks** it reaches the **receptaculum chyli,**[140] which is continued upwards as the **thoracic duct**. Numerous *glands* surround the aorta, those on the right side lying both in front of and behind the inferior vena cava. The aortic lymph stream is thus a complex system of freely inter-

communicating vessels and glands, and it may best be studied by artificially dividing it into its component parts.

The **pelvicrural lymph** from the common iliac streams flows through vessels which ascend on the sides of the aorta, finally converging into *two lateral trunks* which join the *receptaculum* chyli. The vessels are interrupted by numerous *glands* on the sides of the aorta, those on the right side lying both in front of and behind the inferior vena cava.

The **paired-parietal lymph** from the lumbar streams,[162] and

The **paired-visceral lymph** from the suprarenal, renal, and spermatic streams[129] join company with the pelvicrural lymph. It flows through vessels which pass to *glands* on the sides of the aorta.

The **unpaired-visceral lymph.**

(*a*) From the **cœliac**[113] **and superior mesenteric**[71] streams the lymph flows through vessels which converge into an *anterior trunk* which joins the receptaculum chyli. The vessels are interrupted by *glands* in front of the aorta and around the trunks of the cœliac and superior mesenteric arteries.

(*b*) From the **inferior mesenteric stream**[71] the lymph joins company with the pelvicrural lymph. It flows through vessels which pass to *glands* on the sides of the aorta either directly or by way of *glands* in front of the aorta beside the origin of the inferior mesenteric artery.

In addition, from the **unpaired-visceral, paired-visceral, parietal, and pelvicrural** streams some lymph flows through vessels which pass behind the

aorta, converging into a *posterior trunk* which joins the receptaculum chyli. Besides the *glands* in front and on the sides of the aorta, through which this lymph may have passed, the vessels are interrupted by *glands* on the back of the aorta.

140. The **receptaculum chyli** (Cisterna chyli) is merely the dilated commencement of the thoracic duct. It lies in the epigastric region in front of the first and second lumbar vertebræ immediately to the right of the aorta, under cover of the right crus of the diaphragm. In addition to the **four ascending trunks** just described it receives **two descending trunks** which pass from thorax to abdomen by way of the aortic opening in the diaphragm.

141. The **thoracic duct** (Ductus thoracicus), lying immediately to the right of the aorta, ascends from the receptaculum chyli through the aortic opening in the diaphragm.

142. **TRIBUTARIES**[139] OF THE AORTIC LYMPH STREAM.

VISCERAL.		PARIETAL.		PELVICRURAL.
Unpaired-visceral.	Paired-visceral.	Paired.	Unpaired.	Paired.
Cœliac.		L		
Sup. mesenteric.	Suprarenal.	u		
	Renal.	m		
	Spermatic.	b		
Inf. mesenteric.		a		
		r		Common iliac.
				Ext. iliac.
				Int. iliac.

143. NERVES (SYMPATHETIC).

i. Abdominal **aortic sympathetic plexus** (Plexus cœliacus + Plexus aorticus abdominalis).—In the abdomen the aorta [131] is accompanied by the great aortic plexus of sympathetic nerve fibres. In its upper part (Plexus cœliacus), beside the origins of the cœliac and mesenteric arteries, the aortic plexus is interspersed with ganglia of which the largest are known as the **semilunar ganglia** (Ganglia cœliaca). In its lower part the fibres are gathered into bundles which, under the name of the **hypogastric nerves**, descend in front of and behind the bifurcation of the aorta and the origins of the common iliac arteries to the sacral promontory where they form the **hypogastric plexus** (Plexus hypogastricus). The aortic plexus *distributes* subordinate plexuses to branches of the abdominal aorta, namely, the inferior phrenic,[152] the cœliac,[113] superior mesenteric, and inferior mesenteric,[72] and the suprarenal, renal, and spermatic [129] plexuses. It *receives* (*a*) the splanchnic nerves, formed by the union of the lower peripheral branches of the thoracic portion of the sympathetic cords, and (*b*) the peripheral branches of the lumbar portion of the sympathetic cords.

The **semilunar ganglia** are two large irregular ganglionic masses which lie between the suprarenal capsules in front of the crura of the diaphragm, the right ganglion being behind the inferior vena cava. They *distribute* radiating branches (1) upwards to form the inferior phrenic plexuses; (2) inwards and also downwards to accompany the aorta, and to join the cœliac and superior mesenteric plexuses; (3) outwards and also downwards to join the suprarenal and renal

plexuses. They *receive* the 1st and 2nd splanchnic nerves.

144. ii. (*a*) The **splanchnic nerves** are formed by the union of the *lower peripheral branches of the thoracic portion of the sympathetic cords*, and they pierce the diaphragm just above the crura. On each side the 1st and 2nd nerves (N. splanchnicus major, minor) join the semilunar ganglion, the former at the upper, the latter at the lower end (aorticorenal ganglion). The 3rd nerve (N. splanchnicus imus) joins the renal plexus.

(*b*) The **peripheral branches of the lumbar portion of the sympathetic cords** pass inwards in an irregular manner to join the aortic plexus.

145. iii. The **lumbar portion of the sympathetic cords.** The gangliated cords (Truncus sympathicus) enter the abdomen either by piercing or by passing behind the diaphragm, they descend immediately in front of the anterior common ligament and vertebral column, external to the crura of the diaphragm, and along the inner margin of the psoas muscle, and they leave the abdomen by passing behind the common iliac arteries. The ganglia are irregular in number (4 to 8) and in disposition, and are linked into a chain by commissural cords. They *distribute* irregularly

Peripheral branches, and also

Gray rami communicantes[163] to the anterior primary divisions of the lumbar spinal nerves. They *receive*

White rami communicantes[163] from the anterior primary divisions of the 1st and 2nd, possibly also of the 3rd and 4th lumbar nerves.

Note. — The rami communicantes

accompany the lumbar vessels beneath the tendinous arches [154] of the psoas fascia.

Note.—The aortic plexus, as far as the origin of the superior mesenteric artery, is known as the **solar or epigastric plexus.**

Note.—The inferior phrenic plexuses are derived from the semilunar ganglia only; the cœliac and superior mesenteric, the suprarenal and renal plexuses, both from the semilunar ganglia and from the plexus on the aorta; the inferior mesenteric and the spermatic plexuses from the plexus on the aorta only. The suprarenal plexus on each side receives twigs from the inferior phrenic and renal plexuses (cf. Arteries [129]) and the renal plexus distributes twigs to the suprarenal and spermatic plexuses (cf. Veins [129]).

146. **OFFSHOOTS** [143] OF THE AORTIC PLEXUS.

	VISCERAL.		PARIETAL.
	Unpaired-visceral.	Paired-visceral.	Paired.
Semilunar ganglia.	Cœliac.		Inf. phrenic.
Plexus on the aorta.	Sup. mesenteric.	Suprarenal.	
		Renal.	
		Spermatic.	
	Inf. mesenteric.		

III.

ROOF AND POSTERIOR ABDOMINAL WALL.

147. **ROOF.** The roof consists of

MUSCULO-APONEUROTIC WALL.

(*a*) Bounding fascia.
(*b*) Diaphragm muscle and tendon.
(*c*) Vessels and nerves.

148. (*a*) The **BOUNDING FASCIA**[25, 154] on the roof consists of the thin diaphragmatic fascia which is continuous below with the fascia transversalis and the fasciæ of the quadratus lumborum and psoas muscles.

149. (*b*) The **DIAPHRAGM** (Diaphragma) is the musculo-tendinous septum which forms the floor of the thoracic and the roof of the abdominal cavity. It lies beneath the lungs and heart and above the liver and stomach in the shape of a dome consisting of two cupolæ separated by a depression, the right cupola being the higher. The muscle fibres take origin from the circumference of the outlet of the thorax and are inserted into the central tendon.

Origin.—On each side

From the posterior surface of the ensiform cartilage.

From the deep surface of the 7th, 8th, 9th, 10th, 11th, and 12th costal cartilages, interdigitating with the transversalis.[23]

From the front of the quadratus fascia by means of the **ligamentum arcuatum externum.**[154]

From the front of the psoas fascia by means of the **ligamentum arcuatum internum.**[154]

From the front of the bodies of the upper lumbar vertebræ by means of the **crus** (Crus mediale) on the right side from the 1st, 2nd, and 3rd; on the left from the 1st and 2nd only.

Note.—The external and internal arcuate ligaments are merely thickenings of the quadratus and psoas fasciæ respectively. Behind the externum the quadratus muscle ascends to its insertion into the 12th rib, behind the internum the psoas descends from its origin from the 12th thoracic vertebra.

Insertion.—From the circumferential origin the muscle fibres pass on every side to the **central tendon** (Centrum tendineum), which is trifoliate. The lateral leaflets, of which the right is the larger, extend outwards and backwards, the middle leaflet comes forward towards the ensiform cartilage.

Direction of fibres.—The muscle fibres vary greatly in their course from origin to insertion.

The anterior fibres pass almost horizontally backwards,

The costal fibres obliquely upwards and inwards,

The posterior fibres almost vertically upwards.

150. **Openings.**—There are two great openings in the substance of the diaphragm, the **foramen quadratum**[136] (Foramen venæ cavæ) in the right lateral leaflet, and the **œsophageal opening**[91] (Hiatus œsophageus) behind the base of the left lateral leaflet. The *aortic opening*[131] (Hiatus aorticus) lies behind the diaphragm between the crura, which are connected

by a fibrous arch known as the *middle arcuate ligament.*

151. *Note.*—**Structures which pass through the thoracic outlet** from thorax to abdomen or *vice versa.*

A. Beside the circumference of origin.
  Between the xiphisternal and the first costal slips.
    Superior epigastric vessels.[17]
  Between the various costal slips.
    Musculophrenic vessels.[29]
    Thoracic nerves,[31] 7th, 8th, 9th, 10th, and 11th.
  Behind the ligamenta arcuata externa.
    Subcostal vessels.[160]
    12th thoracic nerves.[164]
  Behind the ligamenta arcuata interna.
    Gangliated cords of the sympathetic.
  Between the crura (aortic opening).
    Aorta.[131]
    Receptaculum chyli and thoracic duct.[140]
    Vena azygos major.[161]

B. Through the substance of the diaphragm.
  Through the crura.
    Vena azygos minor inferior.[161]
    Splanchnic nerves.[143]
  By way of the foramen quadratum.
    Inferior vena cava.[136]
    Phrenic nerve filaments.[152]
  By way of the œsophageal opening.
    Œsophagus.[91]
    Pneumogastric nerves.[118]

152. **VESSELS AND NERVES** OF THE DIAPHRAGM.

Arteries.	Veins.	Lymphatics.	Nerves.
(Superior phrenic). Inferior phrenic.		*Various.*	Phrenic (spinal). Inferior phrenic (symp.).

ARTERIES.

[The *superior phrenic* arteries (A. pericardiacophrenica), derived from the internal mammary arteries, accompany the phrenic nerves.]

The **inferior phrenic** arteries (A. phrenica inferior) arise either separately or by a common trunk from the front of the abdominal aorta.[132] Each artery runs upwards and outwards over the crus of the diaphragm and divides into two branches of which the anterior passes forwards in front of the central tendon to anastomose with its fellow, the posterior passes inwards and downwards to supply the lower costal fibres. Branch—**suprarenal.**[129]

VEINS correspond to the arteries.

LYMPHATICS accompany the vessels and communicate freely with those on the thoracic surface of the diaphragm.

NERVES.

The **phrenic nerves** (spinal) (N. phrenicus) descend through the thorax to pierce the diaphragm on each side of the central tendon, supplying the muscle from its abdominal surface. Some filaments pass through the foramen quadratum.

The **inferior phrenic sympathetic plexuses** (Plexus phrenicus), offshoots of the aortic plexus,[143] accompany the inferior phrenic arteries.

153. POSTERIOR WALL.

1. Musculo-aponeurotic wall.
   (*a*) Bounding fascia.
   (*b*) Muscles and aponeuroses.
   (*c*) Deep fascia.
   Vessels and nerves.
2. Superficial fascia and skin.
   Vessels and nerves.

154. I. MUSCULO-APONEUROTIC WALL.

(*a*) The **BOUNDING FASCIA** [25, 148] is made up of the

Fascia transversalis,
Fascia of the quadratus lumborum,
Fascia of the iliopsoas (fascia iliaca).

Fascia transversalis (Id.).—The fascia transversalis has already been described [25] in relation to the anterior and lateral walls. Behind, it becomes fused with the posterior aponeurosis of the transversalis [156] to form the fasciæ of the quadratus lumborum and psoas muscles.

Fascia of the quadratus lumborum.—Externally this is continuous with the fascia transversalis, internally with the fascia of the psoas. Above, it is thickened to form the **ligamentum arcuatum externum** [146] (Arcus lumbocostalis lateralis Halleri); below, it is thickened to form the **iliolumbar ligament.**

Fascia of the iliopsoas or fascia iliaca.

Above the false pelvis it covers the psoas.

Externally, it is continuous with the fascia of the quadratus lumborum.

Internally, it is tacked down to the anterior common ligament along the inner limit of the psoas, except opposite the middle of the vertebral bodies, where **tendinous arches**[157] provide for the passage of the lumbar vessels[160] and the rami communicantes[145] of the sympathetic cord.

Above, it is thickened to form the **ligamentum arcuatum internum** (Arcus lumbocostalis medialis Halleri).

Below, it descends into the false pelvis.

In the false pelvis it spreads itself out over the iliopsoas and no septum separates the two component muscles.

Externally and in front, it is tacked down to the inner lip of the iliac crest and the posterior margin of Poupart's ligament in continuity with the fascia transversalis[25] except opposite the femoral vessels.[131] Here the fascia transversalis descends in front of the vessels to form the anterior, while the fascia iliaca descends behind the vessels to form the posterior wall of the **femoral sheath.**

Internally, it is tacked down to the pelvic brim in indirect continuity with the bounding fascia of the pelvis.

155. (*b*) **MUSCLES AND APONEUROSES.**

(*a*) **Lateral.**

Transversalis and its posterior aponeurosis, the lumbar fascia.
Obliquus internus.
Obliquus externus.

(β) Posterior.

(i) *Sheathed by the lumbar fascia.*

Quadratus lumborum.
Iliopsoas.
Erector spinæ.

(ii) *Arising from and strengthening the posterior lamella of the lumbar fascia.*

Serratus posticus inferior.
Latissimus dorsi.

(α) LATERAL MUSCLES.

156. TRANSVERSALIS MUSCLE[23] and lumbar fascia.—The transversalis ends behind in its posterior aponeurosis which is known as the lumbar fascia. Proceeding backwards the lumbar fascia divides into **two layers** to enclose[157] the quadratus lumborum muscle, and each layer subsequently divides into two, that in front of the quadratus to enclose the psoas muscle, that behind the quadratus to enclose the erector spinæ muscle. The **four layers** are finally attached along the vertebral column as follows: (1) To the intervertebral discs above all the lumbar vertebræ, the adjacent parts of the vertebral bodies, and the tendinous arches; (2) to the front of the roots of the transverse processes; (3) to the tips of the transverse processes; (4) to the spines of the vertebræ and the supraspinous ligaments.

OBLIQUUS INTERNUS.[21] *Origin*, behind by a posterior aponeurosis which at first is fused with but soon becomes distinct from the posterior lamella of the lumbar fascia.

OBLIQUUS EXTERNUS.[19] Behind,

between origin and insertion the muscle has a fleshy *free border* ascending from the iliac crest inwards and disappearing behind the anterior border of the latissimus dorsi,[158] by which muscle the obliquus externus is to some extent overlapped. The interval between the two muscles just above the iliac crest is called the *triangle of Petit* (Trigonum lumbale Petiti).

(β) POSTERIOR MUSCLES.

157. (i) Sheathed by the lumbar fascia.

QUADRATUS LUMBORUM (M. quadratus lumborum). *Origin*, from the posterior part of the iliac crest, from the iliolumbar ligament, and from the transverse processes of the lower lumbar vertebræ. *Insertion*, into the inner part of the lower border of the last rib, and into the transverse processes of the upper lumbar vertebræ.

PSOAS (M. psoas major). The psoas muscle takes origin alongside the whole lumbar portion of the vertebral column, descends in front of the pelvic brim and is inserted into the lesser trochanter of the femur. *Origin*—(1) By five thick fleshy slips from the intervertebral discs above all the lumbar vertebræ, the adjacent parts of the vertebral bodies (12th thoracic to 5th lumbar), and the tendinous arches[154] which span the middle of the vertebral bodies to provide for the passage of the lumbar vessels and the rami communicantes of the sympathetic cord; (2) by five slender slips from the anterior surface and lower border of the transverse processes of all the lumbar vertebræ. *Insertion*, into the apex of the small trochanter of the femur conjointly with the iliacus. The ILIACUS muscle (M. iliacus) is not in relation with the lumbar fascia, but occupies the

false pelvis external to the psoas. *Origin*, from the upper and outer part of the venter ilii, from the anterior sacro-iliac ligament, and from the ala of the sacrum. *Insertion*, into the tendon of the psoas, the small trochanter, and below that the shaft of the femur.

ERECTOR SPINÆ (M. sacro-spinalis). *Origin*, from the crest of the ilium, the posterior sacro-iliac ligament, the back of the sacrum, and the spines and supraspinous ligaments of the upper sacral and all the lumbar vertebræ. In the posterior abdominal wall, it forms a thick solid mass which is prolonged upwards.

158. (ii) **Arising from and strengthening the vertebral aponeurosis, *i.e.* the posterior lamella of the lumbar fascia.**

SERRATUS POSTICUS INFERIOR (M. serratus posterior inferior). *Origin*, by means of the lumbar fascia from the 11th and 12th thoracic and 1st and 2nd lumbar spines. *Insertion*, by four muscular slips into the 9th, 10th, 11th, and 12th ribs.

LATISSIMUS DORSI (M. latissimus dorsi). *Origin*, by fleshy fibres from the posterior part of the iliac crest, and then by means of aponeurosis from the back of the sacrum, and the spines and supraspinous ligaments of the upper sacral, all the lumbar and the lower 6 thoracic vertebræ; also from the lower 3rd or 4th ribs by slips which interdigitate with the obliquus externus,[19] and from the inferior angle of the scapula. *Insertion*, into the floor of the bicipital groove of the humerus. From the iliac crest the anterior border of the latissimus dorsi ascends outwards, forming the posterior side of

the triangle of Petit, and it then overlaps the obliquus externus.[156]

Note.—The posterior lamella of the lumbar fascia is not a separate structure giving origin to the various muscles, but is itself the result of the fusion of their aponeuroses with each other and with the deep fascia.

159. (*c*) **DEEP FASCIA.**[11] The deep fascia covers the latissimus dorsi, the obliquus externus, and within the triangle of Petit the obliquus internus. It helps to form the posterior lamella of the lumbar fascia.[158]

160. **VESSELS AND NERVES** OF THE POSTERIOR ABDOMINAL WALL.

Arteries.	Veins.	Lymph Streams.	Nerves (spinal).
		Subcostal.	12th thoracic.
		Lumbar.	Lumbar.
Middle sacral.			

ARTERIES.

The **subcostal** arteries (A. intercostalis XII.) are the lowest paired parietal branches of the thoracic aorta. Each runs along the lower border of the 12th rib in company with the 12th thoracic nerve, and passes behind the ligamentum arcuatum externum into the abdomen. Crossing in front of the quadratus lumborum it pierces the posterior aponeurosis of the transversalis, on the superficial aspect of which muscle it proceeds forwards.[29]

The **lumbar** arteries (Aa. lumbales) arise, 4 pairs from the back of the abdominal aorta,[132] the 5th

pair from the middle sacral artery. They run outwards on each side round the middle of the vertebral bodies, the upper pairs passing behind the crura of the diaphragm. Continuing their course behind the tendinous arches[154] of the psoas fascia they pass into the psoas muscle between the two sets of its slips of origin. Beyond the transverse processes of the vertebræ they cross outwards, the last usually in front of, the others behind the quadratus lumborum muscle. Then piercing the posterior aponeurosis of the transversalis they proceed forwards[29] on the superficial aspect of that muscle, the upper arteries reaching the lateral abdominal walls. Branches—

Muscular.

Dorsal (Ramus dorsalis). Opposite the intervals between the transverse processes of the vertebræ each lumbar artery sends a dorsal branch backwards. Branches—

Muscular.
Spinal (Ramus spinalis).
Cutaneous.
Internal.
External.

The **middle sacral** artery (A. sacralis media) arises from the back of the abdominal aorta[132] just above the bifurcation and descends in front of the 4th and 5th lumbar vertebræ to enter the pelvis. It gives off the 5th pair of lumbar arteries.

161. VEINS.

The **lumbar** veins (Vv. lumbales), 5 pairs, correspond to the arteries except that the fifth pair also empty themselves directly into the inferior

vena cava.[137] All the lumbar veins of each side are connected by a longitudinal anastomosing vessel, the **ascending lumbar** vein, which ascends in front of the transverse processes of the lumbar vertebræ to terminate as an azygos vein.

The **vena azygos major** (V. azygos) ascends on the right side through the aortic opening in the diaphragm[151] lying immediately internal to the right crus, and on the right side of the thoracic duct by which it is separated from the aorta.

The **vena azygos minor** inferior (V. hemiazygos) ascends on the left side and pierces the left crus.

The **middle sacral** vein (V. sacralis media) corresponds to the artery but empties itself into the *left common iliac vein.*[136]

162. LYMPHATICS.

The **lumbar** lymphatics accompany the lumbar arteries and end in *glands*[139] on the sides of the aorta. *Glands* may be found between the transverse processes of the vertebræ.

163. NERVES (SPINAL).

12th thoracic (N. thoracalis XII.).
Lumbar (5 pairs) (Nn. lumbales).

Note.—Each of these nerves arises from the spinal cord by a ventral and a dorsal root, the latter of which possesses a ganglion. The two roots unite beside the intervertebral foramen, immediately beyond which the nerve after giving off a minute recurrent branch splits into two primary divisions. (*a*) The anterior primary divisions supply the body-wall and limbs. They receive in an irregular manner gray

rami communicantes from the ganglia of the sympathetic cords,[145] and in the case of the 1st and 2nd, possibly also the 3rd and 4th lumbar nerves, they give off white rami communicantes to the sympathetic cords. (β) The posterior primary divisions supply the muscles and skin of the back.

164. (α) ANTERIOR PRIMARY DIVISIONS (Rami anteriores).

The **12th thoracic** nerve passes outwards behind the psoas and the ligamentum arcuatum externum in front of the quadratus lumborum, and pierces the transversalis, on the superficial aspect of which it proceeds forwards[31] to the lateral and anterior walls.

The **lumbar** nerves combine to form the lumbar plexus and the lumbosacral cord.

A. The **Lumbar plexus** (Plexus lumbalis) often receives a branch from the 12th thoracic nerve. It is formed by the 1st, 2nd, 3rd, and part of the 4th lumbar nerves. Each component nerve divides into two portions, postero-external and antero-internal, and from these portions nerves are derived as follows:—

I. Postero-external.	II. Antero-internal.
1. Iliohypogastric.	
Ilio-inguinal.	
	1, 2. Genitocrural.
2, 3. External cutaneous.	
2, 3, 4. Anterior crural.	2, 3, 4. Obturator.
	(3, 4. Accessory obturator.)

i. **The iliohypogastric** nerve (N. iliohypogastricus), traversing the psoas to its outer border, passes in front of the quadratus lumborum, beyond which it proceeds above the iliac crest superficial to the transversalis towards the lateral abdominal wall.[31]

The **ilio-inguinal** nerve (N. ilio-inguinalis), traversing the psoas to its outer border below the iliohypogastric nerve, follows a similar course to the lateral abdominal wall.[31]

The **external cutaneous** nerve (N. cutaneus femoris lateralis), traversing the psoas to its outer border, crosses the iliacus to the anterior superior iliac spine where it passes beneath Poupart's ligament to enter the thigh.

The **anterior crural** nerve (N. femoralis), traversing the psoas to its outer border, descends in the groove between the psoas and iliacus muscles to Poupart's ligament, beneath which it enters the thigh external to the femoral sheath.

ii. The **genitocrural** nerve (N. genitofemoralis), traversing the psoas to its anterior surface, descends on the outer side of the common and external iliac vessels behind the ureter, and divides into two branches which proceed to Poupart's ligament.

The **genital** branch (N. spermaticus externus) lies in front of the termination of the external iliac vessels, and passing through the internal abdominal ring accompanies the spermatic cord[22] to end by supplying small branches to the scrotum. *Branches* are also given off (*a*) to the external iliac artery, (*b*) to the cremaster muscle, (*c*) to join the spermatic plexus.

The **crural** branch (N. lumbo-inguinalis) descends into the thigh, lying in front of the outer side of the femoral artery within the femoral sheath.

The **obturator** nerve (N. obturatorius), traversing the psoas to its inner border, descends behind the common and on the outer side of the internal iliac vessels to enter the pelvis.

(The **accessory obturator** nerve when present, traversing the psoas to its inner border, passes forwards over the pelvic brim behind the external iliac vessels and then descends over the front of the os pubis into the thigh.)

B. **Lumbosacral cord** (Truncus lumbosacralis).—The remaining part of the 4th and the whole of the 5th lumbar nerve, traversing the psoas to its inner border, divide each into an anterior and a posterior branch. The two anterior and the two posterior branches unite to form respectively an anterior and a posterior trunk which together are known as the lumbosacral cord, descending into the pelvis to help in the formation of the *sacral plexus*.

165. (β) POSTERIOR PRIMARY DIVISIONS (Rami posteriores).

12th thoracic. — Passing backwards through the erector spinæ the nerve divides into an internal, **muscular** (Ramus medialis), and an external **cutaneous** branch [166] (Ramus lateralis).

Lumbar. — The 1st, 2nd, and 3rd divide similarly each into an internal, **muscular** (Ramus medialis), and an external **cutaneous** branch [166] (Ramus lateralis).

The 4th and 5th usually

supply only **muscular** branches. The 5th may send a communicating branch to the 1st sacral.

166. II. SUPERFICIAL FASCIA AND SKIN.

The **SUPERFICIAL FASCIA** (Tela subcutanea) is usually thick, containing a quantity of fat.

VESSELS AND NERVES.

ARTERIES.

The **dorsal** branches (Rami dorsales) of the lumbar arteries terminate by dividing into **internal and external cutaneous** branches.

VEINS.

LYMPHATICS.

Groinward.— Below the umbilicus the superficial lymphatics converge on the superficial inguinal *glands*.

Axillaward.—Above the umbilicus they converge on the axillary glands which are all deep.

NERVES.

11th and 12th thoracic.
1st to 3rd lumbar.

The external [165] cutaneous branches (Rami laterales) of all these nerves descend and become superficial above the iliac crest, over which they cross to supply the skin of the thigh.

167. SKIN (Cutis).—Through the skin can be felt the 12th rib above, the iliac crest below, and the 12th thoracic and all the lumbar spines in the middle line. The skin surface presents a mesial spinal furrow banked on each side by the prominence of the erector spinæ muscle.

APPENDIX.

A. FEMALE.

i. The **inguinal canal** is considerably smaller than in the male, but has the same boundaries.

The **round ligament of the uterus** (Lig. teres uteri) passes from the uterus to the parietes, traverses the inguinal canal, and ends in the superficial fascia and skin of the labium majus.

The **canal of Nuck**, a small diverticulum of the peritoneal sac corresponding to the processus vaginalis, is occasionally found accompanying the round ligament of the uterus within the inguinal canal.

ii. The ovaries with their vessels and nerves.

The **ovaries** (Ovarium), like the testes, originally lie entirely within the cavity of the abdomen proper. In the adult they lie in the pelvic cavity.

The **ovarian arteries** (A. ovarica) in the upper part of their course resemble the spermatic arteries. About the level of the anterior superior spine, however, each artery turns inwards and then passing in front of the external iliac vessels enters the pelvic cavity. The ovarian **veins, lymphatics, and sympathetic nerve plexuses** correspond to the arteries.

B. *PERITONEUM*

INVAGINATIONS OF THE PERITONEAL SAC.

In the course of development the peritoneal sac[34] presents numerous invaginations,* a few examples of which are given in Figs. 6 *a*–15 *a*. (In each of these figures or "*ribbon-sections*" the portion of the ribbon which constitutes the invagination is indicated in section by a continuous line. In Figs. 16 *a* and 17 *a* only that portion of the invagination is indicated which is made up of the gastric sheet[99]).

Some invaginations are comparatively **simple** (Figs. 6 *a*–13 *a*), others are more **complex** (Figs. 14 *a*–17 *a*).

(i) Some are due to a **true process of invagination** of the parietal peritoneum by organs or other structures, *e.g.* by the liver[76, 79, 80] (Fig. 6 *a*), by the jejuno-ileum[66] (Fig. 10 *a*), by the common bile-duct, hepatic artery, and portal vein[89] (Fig. 11 *a*). (ii) Others are the result of **changes in the true invaginations** through adhesion and absorption of apposed peritoneal surfaces, *e.g.* the colon,[57] at one time moored to the wall (Fig. 9 *a*), becomes in part fixed to the wall (Fig. 8 *a*) and to the kidney (Fig. 14 *a*), and even[61] incorporated within the greater mooring of the stomach (Fig. 17 *a*). (iii) Other invaginations again arise from mere **puckering** of the peritoneum, *e.g.* the duodenal folds[65] (Fig. 13 *a*).

EVAGINATIONS OF THE PERITONEAL SAC.

The peritoneal sac presents but one instance of evagination, namely, the processus vaginalis[128] (Fig. 19).

* An indentation[34] is merely a form of invagination.

RECESSES OF THE PERITONEAL CAVITY.

Every **evagination** of the peritoneal sac contains a recess of the peritoneal cavity (Fig. 19).

Every **invagination** of the sac is in relation to two recesses. Some examples are given in Figs. 6 *b*–17 *b*, in each of which the portion of peritoneum which bounds the recess is indicated in section by a continuous line. Thus in Fig. 6 *b* the invagination of the sac by the liver gives rise to two recesses of the peritoneal cavity, one above between the liver and the diaphragm, the other below between the liver and the right kidney. In Figs. 16 *b*, 17 *b*, the recess of the small sac[98] is shown.

FOLDS OF THE PERITONEUM.

In spite of the complexity of the peritoneal sac there can be only two forms of peritoneal folds, the **serous-from-serous** fold, in which the serous surfaces are turned away from each other, and the **serous-to-serous** fold, in which they are turned towards each other.

(i) Every invagination of the peritoneal sac is a serous-from-serous fold (Figs. 6 *a*–17 *a*).

(ii) Every recess of the peritoneal cavity is bounded by a serous-to-serous fold (Figs. 6 *b*–17 *b*, 19).

(iii) A peritoneal invagination may itself be folded, in which case the peritoneum on its sides forms folds of both the serous-from-serous and the serous-to-serous type (Figs. 16 *b*, 17 *b*, 18). The gastric sheet[99] is an example of a simple, the mesentery proper[66] of a more complex folding.

REFLECTIONS OF THE PERITONEUM.

The peritoneum which covers the wall is **parietal peritoneum,** that which covers the organs is **visceral peritoneum,** while that which intervenes between the wall and the organs and between the various organs is made up of **peritoneal reflections** (Figs. 6 *c*–10 *c*, 11 *a*–13 *a*, 14 *c*–17 *d*). Peritoneal reflections are for the most part studied in pairs, each pair forming a **double reflection.**

Double peritoneal reflections in relation to organs are of two kinds.

(i) **Parts of invaginations or folds** due to *organs* (Figs. 6 *c*–10 *c*, 14 *c*–17 *d*). Thus in Fig. 6 *c* the diaphragm is covered by parietal, and the liver and kidney by visceral peritoneum, while a peritoneal reflection intervenes above [76] between diaphragm and liver, and another below [80] between liver and kidney. Such reflections, whether taken singly or in pairs, do not constitute folds.

(ii) **Complete invaginations or folds** due to *structures other than organs* or to mere *puckering* (Figs. 11 *a*–13 *a*). Peritoneal reflections in relation to structures other than organs (Figs. 11 *c*, 12 *c*) are of no importance, but since such structures may pass from the wall to an organ, or from one organ to another, the folds which they cause may constitute peritoneal reflections of organs. Thus the fold of the umbilical vein [76] (Fig. 12 *a*) is a double reflection of peritoneum from the wall to the liver, while the fold of the common bile-duct, hepatic artery, and portal vein [89] (Figs. 11 *a*, 16 *c*, *d*, 17 *c*, *d*, 18) is a double reflection of peritoneum between the liver and the stomach. Similarly the colicophrenic fold [57]

(Fig. 13 *a*, *c*) is a double reflection of peritoneum from the colon to the diaphragm.

PERITONEAL LIGAMENTS.

"A peritoneal ligament is any peritoneal attachment of an organ, either to another organ or to the walls or roof of the abdominal cavity." [35]

It is often said that the organs are "fixed by connective tissue" or "suspended by blood-vessels," or again "suspended by peritoneum." The complete attachment of an organ, however, consists of **peritoneum** *and* **extraperitoneal connective tissue** *and* **vessels and nerves** (Figs. 6 *c*–10 *c*, 11 *a*–13 *a*, 14 *c*–17 *d*), and it is this complete attachment which ought to be termed a ligament, or more properly a peritoneal ligament, since certain organs have ligaments of another type.

When a peritoneal ligament **moors** an organ (Figs. 9 *c*, 10 *c*, 15 *c*–17 *d*, 18), its constituents are intimately related to one another, but when the ligament **fixes** an organ (Figs. 6 *c*–8 *c*, 14 *c*–17 *c*), the relation of its constituents is much less intimate.

The **peritoneal constituent** of a ligament consists of a *double peritoneal reflection*, which is either part of an invagination or fold due to one or more organs (Figs. 6 *c*–10 *c*, 14 *c*–17 *d*), or else a complete invagination or fold due to some structure or structures other than organs or to mere puckering (Figs. 11 *a*–13 *a*). There are accordingly *two types* of ligaments, one without, the other with a free border.

The relation of a peritoneal ligament to the **blood-vessels** of the organ which it attaches necessarily varies. Contrast Figs. 6 *c*–10 *c*, 14 *c*, 15 *c*, Figs. 11 *a*, 12 *a*, and Fig. 13 *a*.

Subdivision of a ligament is sometimes necessary,

in which case each of its parts is also called a ligament. Thus the *liver*[86] is attached to the parietes and viscera by one great unnamed ligament. The portions of this ligament which attach the liver to the parietes on the one hand, and to the stomach and duodenum on the other, are in this work termed the hepatoparietal and hepatogastroduodenal ligaments respectively. The hepatogastroduodenal ligament ("small omentum") is divided by some anatomists into the hepatogastric and hepatoduodenal ligaments. The hepatoparietal ligament is in this work divided into the falciform and hepatophrenic ligaments. The hepatophrenic ligament is in turn generally divided into the right lateral, coronary, and left lateral ligaments, of which the coronary (Fig. 6 *c*) fixes the liver to the diaphragm and conveys the hepatic veins, while the lateral ligaments (Figs. 13 *a*, *c*) are more of the nature of puckers of peritoneum containing extraperitoneal connective tissue and a few lymphatics. Lastly, that portion of the lower reflection of the coronary ligament (Fig. 6 *c*) which attaches the liver to the right kidney is sometimes called the hepatorenal ligament.

N.B.—It should be carefully noted that in the current descriptions the ligaments (i) consist merely of reflections of peritoneum, (ii) do not include the omenta and mesenteries, (iii) are all called folds, although in many cases this is inaccurate, unless the term fold be used in some hitherto undefined sense.

OMENTA.

"Certain peritoneal ligaments which moor either the stomach or the stomach and floating duodenum directly to other organs are called omenta."[35]

That an omentum is really a form of ligament is recognised by some of the greatest authorities, *e.g.* Quain ("gastrosplenic ligament or omentum"), and the BNA ("ligamentum gastrocolicum").

The stomach is moored to the transverse colon by the gastrocolic ligament[47] (Fig. 17 *d*), which, from its resemblance to an apron, has been called the gastrocolic omentum. Two other ligaments have been termed omenta, not because they resemble aprons, but because, like the gastrocolic omentum, they moor the stomach directly to other organs, namely, to the liver[89] (Figs. 11 *a*, 16 *c*, *d*, 17 *c*, *d*, 18) and the spleen[104] (Fig. 16 *d*). The omenta are therefore merely a group of ligaments, each of which is a "direct gastric mooring." The term omentum is convenient, and should be retained, but since the relation of these ligaments to the stomach is the only justification for the retention of the term, it ought to be quite sufficient to speak of the omenta as **colic, hepatic, splenic,** instead of the customary *gastro*colic, *gastro*hepatic, *gastro*splenic.

N.B.—It is interesting to note that (i) the **colic** omentum owes its origin to the fusion of the transverse mesocolon with the mesogastrium (Fig. 17 *c*, *d*), (ii) the **hepatic** omentum (Figs. 11 *a*, 16 *c*, *d*, 17 *c*, *d*, 18) is due to the common bile-duct, hepatic artery, and portal vein, (iii) the **splenic** omentum results from the development of the spleen within the mesogastrium (Figs. 16 *c*, *d*).

MESENTERIES.

"All peritoneal ligaments which moor floating portions of intestine to the posterior abdominal wall, or to organs which are fixed to that wall, are called mesenteries."[35]

This definition applies only to the mesenteries in their later form. In order to be applicable at all stages of development the definition should read "**the alimentary canal (digestive tube)**" instead of intestine, and the greater mooring of the stomach must be restored to the dignity of a mesentery.

The primitive alimentary canal is a straight tube which becomes moored to the posterior abdominal wall by a continuous serous ligament called the **(dorsal) mesentery.** Subsequently, when the various parts of the digestive tube become differentiated, namely stomach, duodenum, jejuno-ileum or enteron proper, and colon, each part is moored to the posterior abdominal wall by a corresponding portion of the (dorsal) mesentery, and since each of these portions is itself mesentery, it is customary to speak of the mesentery of the stomach, the mesentery of the duodenum, and so on, and to name these **mesogastrium, mesoduodenum, mesentery proper** (Fig. 10 *c*), and **mesocolon** (Fig. 9 *c*). In the course of development the (dorsal) mesentery becomes further modified, and wherever a part of the digestive tube becomes fixed to the wall (Figs. 8 *c*, 15 *c*), or to an organ (Fig. 14 *c*), the corresponding mesentery is lost, so that ultimately there remain in the abdomen proper only the **greater mooring of the stomach,**[97] which is a mesentery, although not usually so named (Figs. 16 *c*, 17 *c*), the **mesentery proper**[66] (Figs, 10 *c*, 15 *c*), and the **transverse mesocolon**[61] (Figs. 9 *c*, 17 *d*). With these may be classed the **meso-appendix,**[59] which moors the appendix to the under surface of the mesentery proper.

The enteron is also in part moored to the roof and anterior abdominal wall by a serous (peritoneal) liga-

ment which is usually described as the "**ventral mesentery**," but while the dorsal mesentery is primarily due to the invagination of the peritoneal sac by the digestive tube (Fig. 10 *a*, *c*), the ventral mesentery owes its origin to the liver and other structures. The *liver* develops in common with the diaphragm, from the inferior surface of which it grows downwards into the abdominal cavity, invaginating the peritoneal sac. Now the *umbilical vein* passes from the umbilicus to the under surface of the liver, so that as the liver grows into the abdominal cavity the vein is dragged downwards away from the anterior wall and roof, invaginating the peritoneum, and giving rise to the falciform ligament of the liver[76] (Fig. 12 *a*). Again, the *common bile-duct*, *hepatic artery*, *and portal vein* pass in company to and fro between the liver and the duodenum, so that as the stomach, which originally lies behind the heart, descends along with the liver into the abdominal cavity, the common bile-duct, hepatic artery, and portal vein are dragged away from the roof, invaginating the peritoneum and giving rise to the hepatogastroduodenal ligament or hepatic omentum[89] (Figs. 11 *a*, 16 *c*, *d*, 17 *c*, *d*, 18). **The peritoneum covering the liver, together with the two folds raised by the umbilical vein and by the common bile-duct, hepatic artery, and portal vein,** are at an early stage of development usually grouped together as the ventral mesentery, but this differs so greatly from the dorsal mesentery in its mode of development that it is doubtful whether it should be called a mesentery at all. If it must be so-called, the distinction might be emphasised by terming it the "**hepatic mesentery**" (cf. hepatic omentum).

In the **current descriptions** the mesenteries con-

sist of peritoneum only, and while the term is usually restricted to the double reflection (Figs. 9 *c*, 10 *c*,) it is sometimes regarded as including the visceral peritoneum also, in which case it signifies the *complete invagination or fold* within which the floating portion of bowel lies. In many ways this is unfortunate.

(i) The *colon* (Fig. 9 *a*), when it becomes *fixed* to the wall and to the kidney, retains the visceral portion of the original invagination (Figs. 8 *a*, 14 *a*), losing only the double reflection by which it was moored (Fig. 9 *c*). Nevertheless it is described as having lost its mesentery.

(ii) The *transverse mesocolon*, according to the descriptions, at first includes the visceral peritoneum (Fig. 9 *a*), but at a later stage consists only of the double reflection by which the colon is moored (Fig. 17 *d*).

(iii) The *mesenteries of the stomach*, dorsal and "ventral," are never described as including its visceral peritoneum, but as consisting only of the double reflections by which the stomach is moored (Figs. 16 *c*, 17 *c*).

(iv) If the mesenteries include visceral peritoneum present usage is *inconsistent*, and confusion is only to be avoided by vagueness. If, on the other hand, the mesenteries be regarded as including no visceral peritoneum, they will be brought into line with the ligaments, of which indeed they, like the omenta, will form a natural group.

In defining the term mesentery special stress is often laid on the fact that every mesentery "conveys **blood-vessels**" to the attached portion of the digestive tube. A comparison of Figs. 6 *c*–10 *c*, 14 *c*–17 *d*, Figs. 11 *a*, 12 *a*, and Fig. 13 *a*, shows that the relation of

the blood-vessels to the ligaments varies in strict accordance with the variation in the development of the invaginations and ligaments, and that the one thing needful for a ligament which aspires to the dignity of a mesentery is that it should moor a portion of the digestive tube to the posterior abdominal wall, or to organs which are fixed to that wall.

THE PREFIX MES- OR MESO-.

The prefix mes- or meso- is variously employed in anatomical description. We are not here concerned with its somewhat unfortunate use in such anthropometric terms as *mesocephalic*, *mesognathous*, and others, but with the part which it plays in the naming of actual structures.

The prefix, which is derived from the Greek word μέσος, middle, is frequently attached to the names of organs and other structures, but its significance in the compound name varies.

I. **Mesencephalon.**
Mesonephros, etc.

In some cases the compound name designates the **middle portion** of the organ or structure named, *e.g.* the mesencephalon is the middle encephalos or mid-brain, the mesonephros is the middle nephros or mid-kidney, and so on.

II. A. **Mesentery.**
B. **Mesovary.**
Mesosalpinx.
Mesometrium.
C. **Mesocardium.**

In other cases the compound name designates the **serous mooring** attaching the organ named to some

other structure which, while it varies for the different ligaments, is definitely fixed for each by common consent and usage.

A. Mesentery.

Derivations such as "Mesencephalon (μέσος, middle, ἐγκέφαλος, brain), Mesentery (μέσος, middle, ἔντερον, intestine,") unless accompanied by some explanation of the use of the prefix, shed no light but rather "darkness visible." Nor is it any help to explain the mesentery as "medium intestinum, or μέσον ἔντερον, middle intestine," or again, "(μέσον ἔντερον) so called from being connected to the middle of the cylinder of the small intestine." The mesentery is not the "middle intestine" or mid-gut, and if a cylinder has a middle it must surely be its axis (cf. centre of a circle).

The clue to the meaning of the term mesentery is probably to be found in the use of the prefix in such a name as Mesopotamia, which has been generally supposed to mean "that (land) which is between river and river." The mesentery, however, is not "that which is between enteron and enteron" but "that which is between enteron and ——." Since the primitive enteron is a floating organ, the term mesentery is applied primarily to the serous (peritoneal) mooring of the *enteron*, and secondarily to such portions of the primitive mooring as persist in later life. From this point of view the greater mooring of the stomach [97] is a mesentery, although it is not usually so described. The nature of the "ventral mesentery" has already been discussed.

If the colon had not become incorporated within the greater gastric mooring and so moored to the stomach, the mesenteries in the adult might have been merely the moorings of the intestine.

B. **Mesovary (mesorchium).**
Mesosalpinx.
Mesometrium.

Certain serous moorings are also found in relation to the *generative organs.*

Mesovarium and mesorchium are the terms applied to the serous (peritoneal) moorings of the *ovary* and *testis.* In the course of development the mesorchium is lost, while the mesovarium ultimately moors the ovary to the posterior surface of the broad ligament of the uterus, dividing it into two parts.

Mesosalpinx is the term applied to the portion of the broad ligament which lies above the mesovaric attachment, mooring the *Fallopian tube or salpinx.*

Mesometrium is the term applied to the portion of the broad ligament which lies below the mesovaric attachment, mooring the *uterus* to the parietes.

C. **Mesocardium** is the term applied to certain serous (pericardial) moorings, which are at one stage found in relation to the *heart.*

N.B.—From time to time an attempt is made to define the term mesentery in such a way as will include the mesovary, mesosalpinx, and mesometrium. Even should this prove to be possible, it is quite unnecessary, provided the prefix is given its proper value. The mesovary, mesosalpinx, and mesometrium resemble the mesentery in being peritoneal moorings, and they all resemble the mesocardium in being serous moorings.

COMPARTMENTS OF THE ABDOMINAL AND PERITONEAL CAVITIES. GREAT AND SMALL SACS.

The invaginations of the peritoneal sac are important, because they subdivide the abdominal and peritoneal cavities.

The *transverse mesocolon*[48] and colon form a sloping partition which divides the abdominal and peritoneal cavities into two unclosed compartments, the **cœliac** above and the **mesenteric** below. The *mesentery proper*[66] and jejuno-ileum divide the mesenteric compartment into a right or **superior mesenteric,** and a left or **inferior mesenteric** compartment.

The *gastric sheet* (Figs. 16 *a*, 17 *a*, 18, 5), also divides the abdominal cavity into two portions, and the peritoneal sac, suffering a corresponding complication, is divided into two complementary portions, which have been named the **great and small sacs.**[97, 98] The small sac is frequently described as a diverticulum derived from and belonging to the great sac. Apart from laying undue emphasis on mere difference of size, such a description is inaccurate, since the small sac is in no way derived from the great sac. In the course of development the anteroposterior partition which originally divides the upper part of the abdominal and peritoneal cavities into right and left portions undergoes certain changes in form and attachments, until finally it may be recognised as consisting of two portions, the falciform ligament,[76] which has remained comparatively unchanged and still divides the peritoneal cavity above and in front of the liver into right and left portions, and the gastric sheet,[97, 98] which, by being pushed towards the left and also downwards, has fallen on to what was originally its right side, and in this way has shut off a considerable portion of the peritoneal cavity behind it. The division of the peritoneal sac into two complementary portions, the great and small sacs, is due entirely to the gastric sheet. The constitution and

attachments of the gastric sheet, when studied constructively, are not difficult to master, and when once this partition is understood the resulting great and small sacs present no further difficulty.

CLASSIFICATION OF THE ORGANS, VESSELS, AND NERVES.

The **organs** [50] are divided into *paired* and *unpaired*, and their **vessels and nerves** [132] into *paired-* and *unpaired-visceral*.

The compartments of the abdominal and peritoneal cavities are due [48, 66] to the development of the unpaired organs and the resulting changes in the disposition of the peritoneum, extraperitoneal connective tissue, vessels, and nerves. It is therefore not unnatural that the **unpaired organs** should be classified [50] according to the **compartments**, and that the compartments themselves should be named [48, 66] after the **unpaired-visceral branches** [132] **of the abdominal aorta.** The relation of the paired organs to the compartments can present little difficulty.

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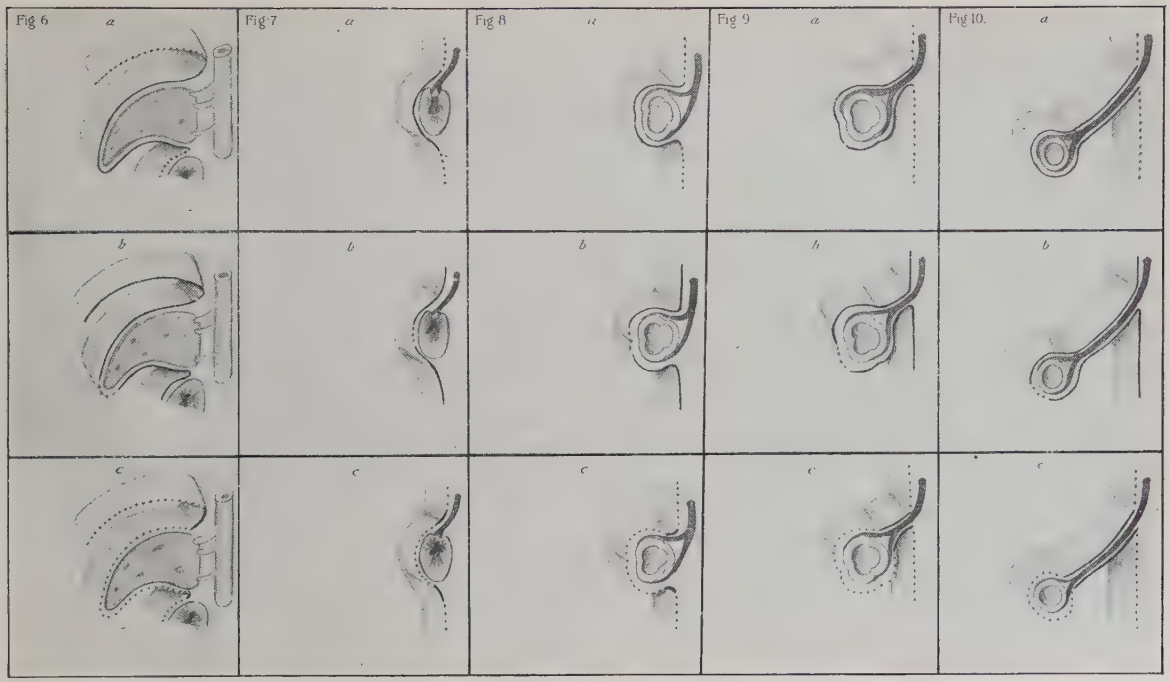
FIG. 6.[75, 76, 79, 80]—**Liver** fixed to the wall. (*a*) *Invagination* of the peritoneal sac = *serous-from-serous fold*. (*b*) *Recesses* bounded by *serous-to-serous folds*. (*c*) *Double peritoneal reflection* which, along with its contents, forms a *ligament* (***CORONARY LIGAMENT*** of the liver).

FIG. 7.[122]—**Kidney** fixed to the wall.

FIG. 8.[57]—**Colon** fixed to the wall.

FIG. 9.[57]—**Colon** moored to the wall. (*a*) Invagination. (*c*) Double peritoneal reflection which, along with its contents, = ***MESOCOLON.***

FIG. 10.[66]—**Jejuno-ileum** moored to the wall. (*a*) Invagination. (*c*) Double peritoneal reflection which, along with is contents, = ***MESENTERY PROPER.***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* † In part fused with the anterior and posterior layers respectively of the lumbar fascia.

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Atlas of Anatomy for Students and General Practitioners.

By Prof. Carl Toldt, M.D., and k.k. Hofrath, Senior Professor of Anatomy in Vienna. Only authorised English Translation from the Third German Edition by M. Eden Paul, M.D.

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